

Lesson 2

Scan Operations and Procedures

Objectives

- Review the guidelines for human scanning and supply references for further information
- To scan safely
- To scan efficiently
- To find the scan data

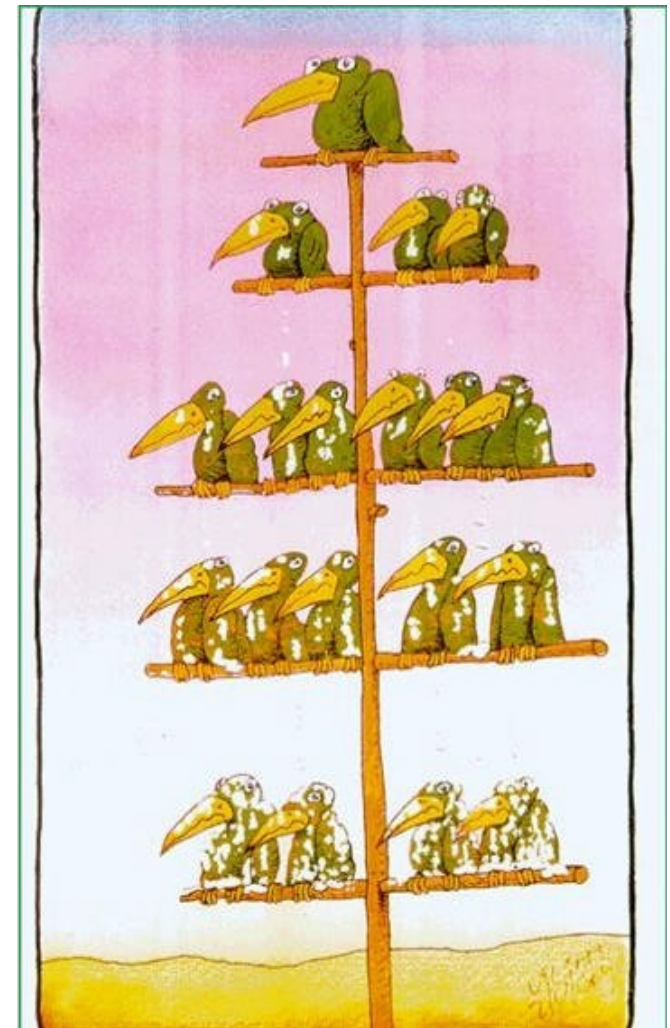
Lesson 2

Scanning Procedures

- The LX icons
- The icon functions

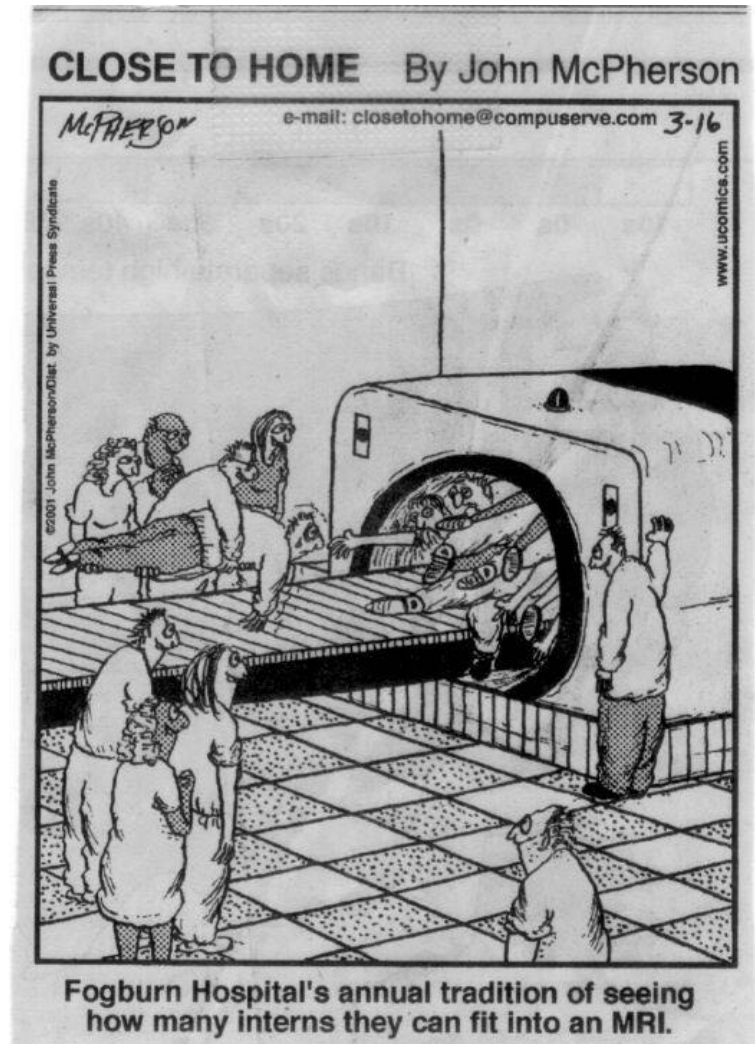
Normal Scan Operations

- Signa Boot/Reboot
- EPI
 - GERT
 - NIH EPI
- Anatomical Scans
- Clinical Scans



Scanner Operations

- The GE Icons
 - General
 - Specific Functions
- Scanner Boot / Reboot Procedures
- EPI Scanning
 - GERT
 - NIH EPI
- Anatomical Scanning
 - Structural Scans
 - Clinical Scans
- Tech Tips and Tricks



The Various GE LX Icons



- Date and Time
- Informix Space
- Message Board
- Scanner Operations
- Protocol Manager
- Browser
- Network
- Tools
- Piece of the Puzzle

Specific Icon Functions and Uses



- Date and Time
 - Use Signa Time for the Logbook and Notes
- *Informix* Image Database Space
- Message Board
- Scanner Operations
- Protocol Manager
- Browser
- Network
- Tools
- Piece of the Puzzle

Specific Icon Functions and Uses



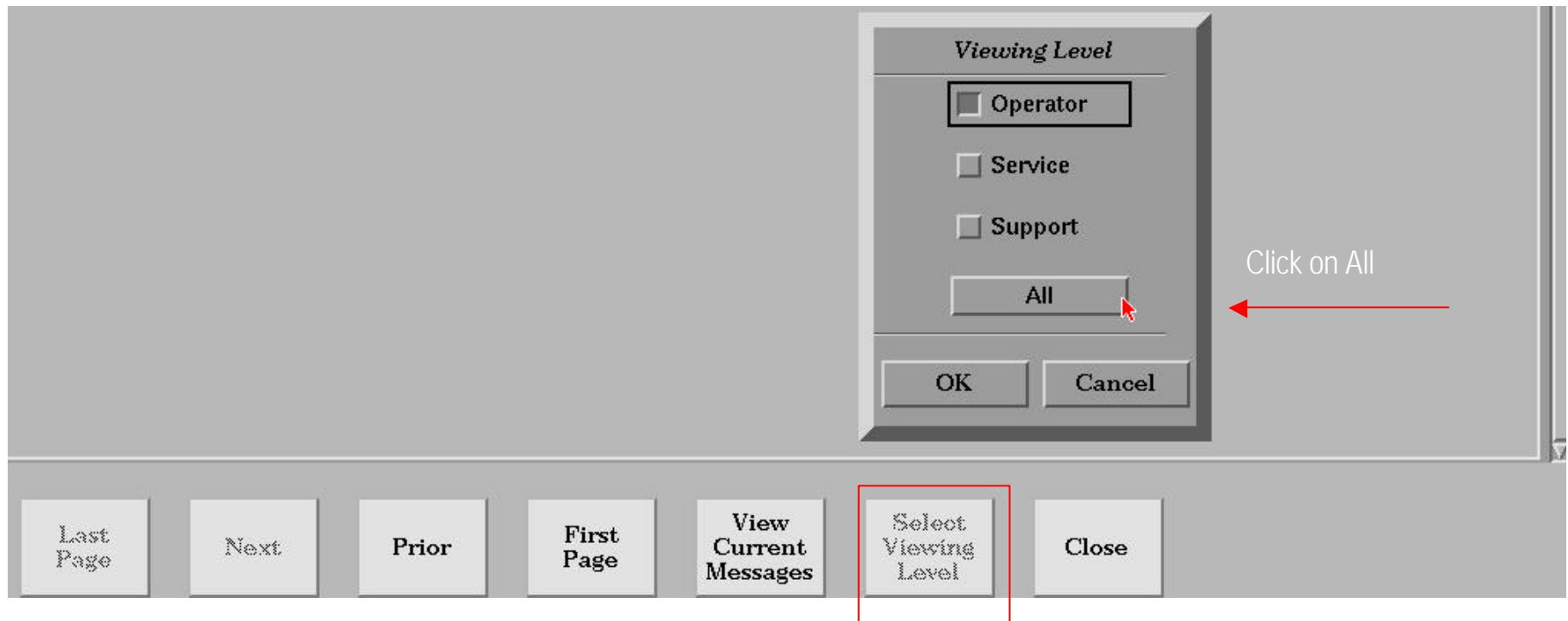
- Date and Time
- *Informix Database*
 - the amount of space per image resolution
 - Percentage of image database that is full
- Message Board
- Scanner Operations
- Protocol Manager
- Browser
- Network
- Tools
- Piece of the Puzzle

Specific Icon Functions and Uses



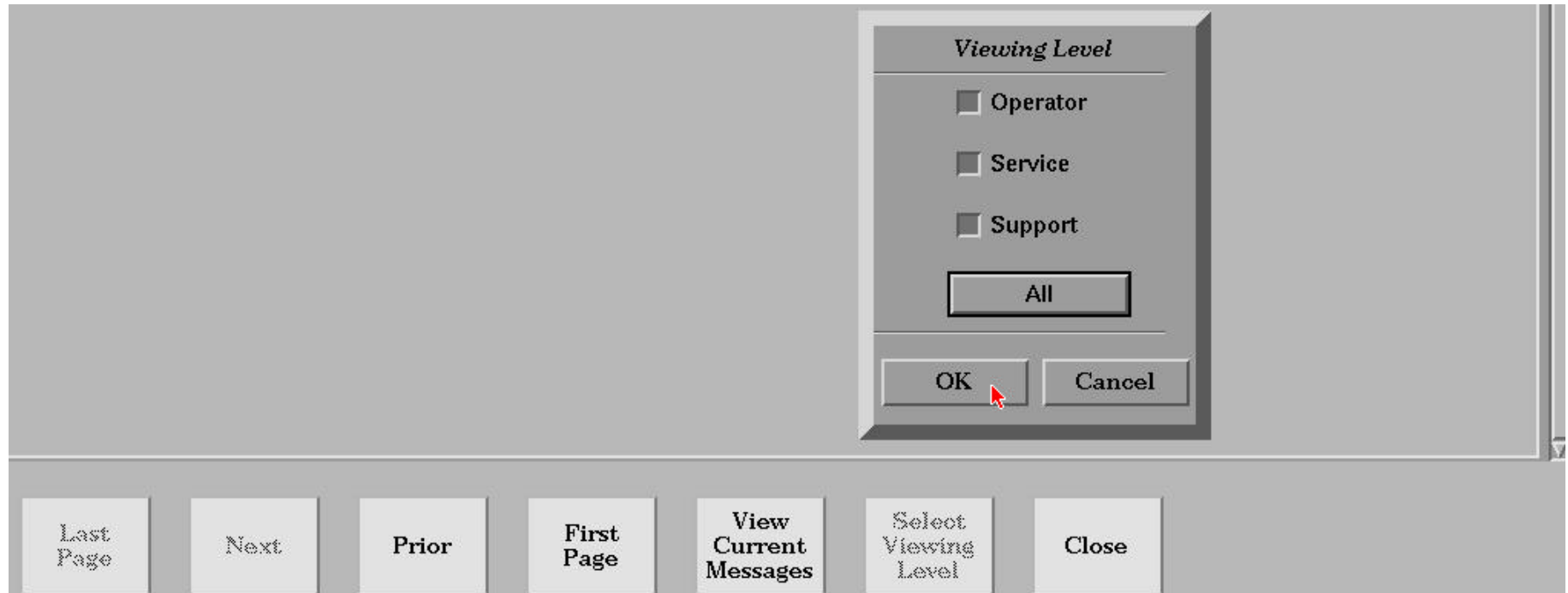
- Date and Time
- *Informix* database space
- **Message Board**
 - Error messages
- Scanner Operations
- Protocol Manager
- Browser
- Network
- Tools
- Piece of the Puzzle

Selecting the Proper Message Level



- Click on the Message Window Icon
- Click on Select **Viewing Level**
- Click on **ALL**
- Click **OK** to close the window

View Message Window



- Click on the Icon_Message Window
- Click on “Select Viewing Level”
 - Click on All
 - Click OK

Example of an Error Message

```
File: ScannerState.c      Line: 982
Internal software error has occurred in scanner state machine. The scanner cannot accept start scan
event, when in refscanning state.

Mon Jun 10 15:21:34 2002
Host: fim3T               Proc: scn               Error: 2218616
File: ScannerState.c      Line: 982
Internal software error has occurred in scanner state machine. The scanner cannot accept start scan
event, when in refscanning state.

Mon Jun 10 15:21:36 2002
Host: fim3T               Proc: scn               Error: 2218616
File: ScannerState.c      Line: 982
Internal software error has occurred in scanner state machine. The scanner cannot accept start scan
event, when in refscanning state.

Mon Jun 10 15:21:38 2002
Host: fim3T               Proc: scn               Error: 2218616
File: ScannerState.c      Line: 982
Internal software error has occurred in scanner state machine. The scanner cannot accept start scan
event, when in refscanning state.

Mon Jun 10 15:21:43 2002
Host: fim3T               Proc: NSP               Error: 2225513
File: HPC_PORT_ID:spi_hpc_scan_   Line: 10
Attention: T/R driver in service, not product mode.

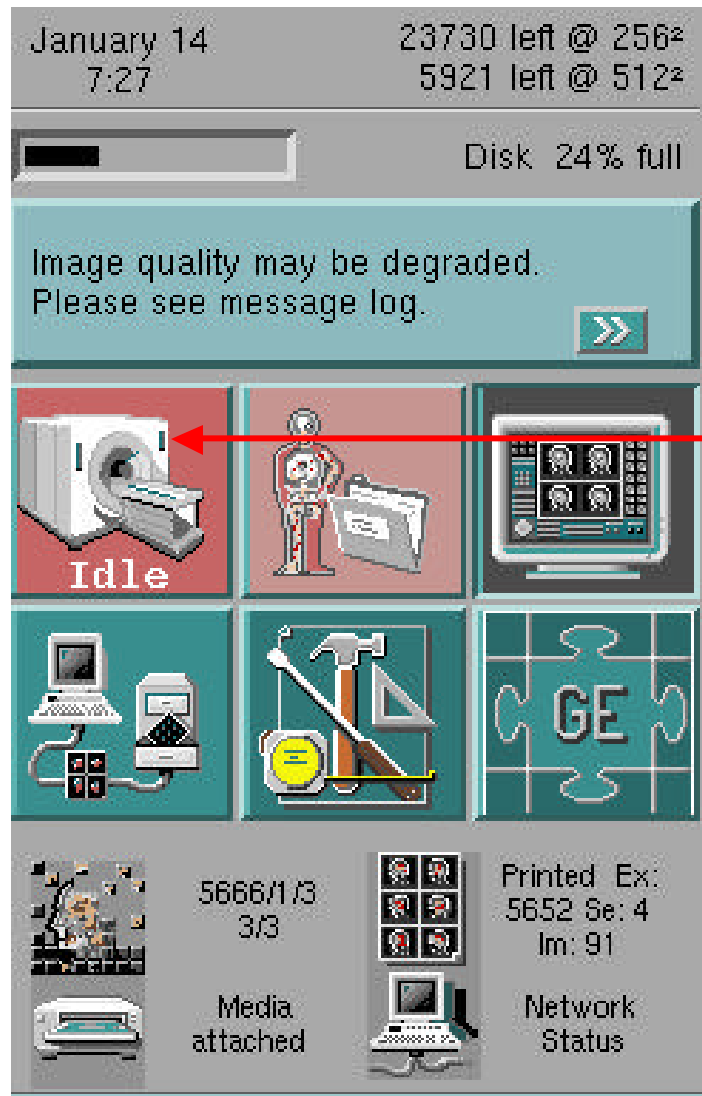
Mon Jun 10 15:22:21 2002
Host: fim3T               Proc: NSP               Error: 2224982
File: HPC_PORT_ID:hpc_pkt_retur   Line: 100
Symbol lookup failed.
HPC received a memory read or load packet or return address packet
to access the symbol cont_recon_queue, which does not exist in the IPG symbol table.
```

Not Useful to keep
trying to scan
with this
particular error
message:

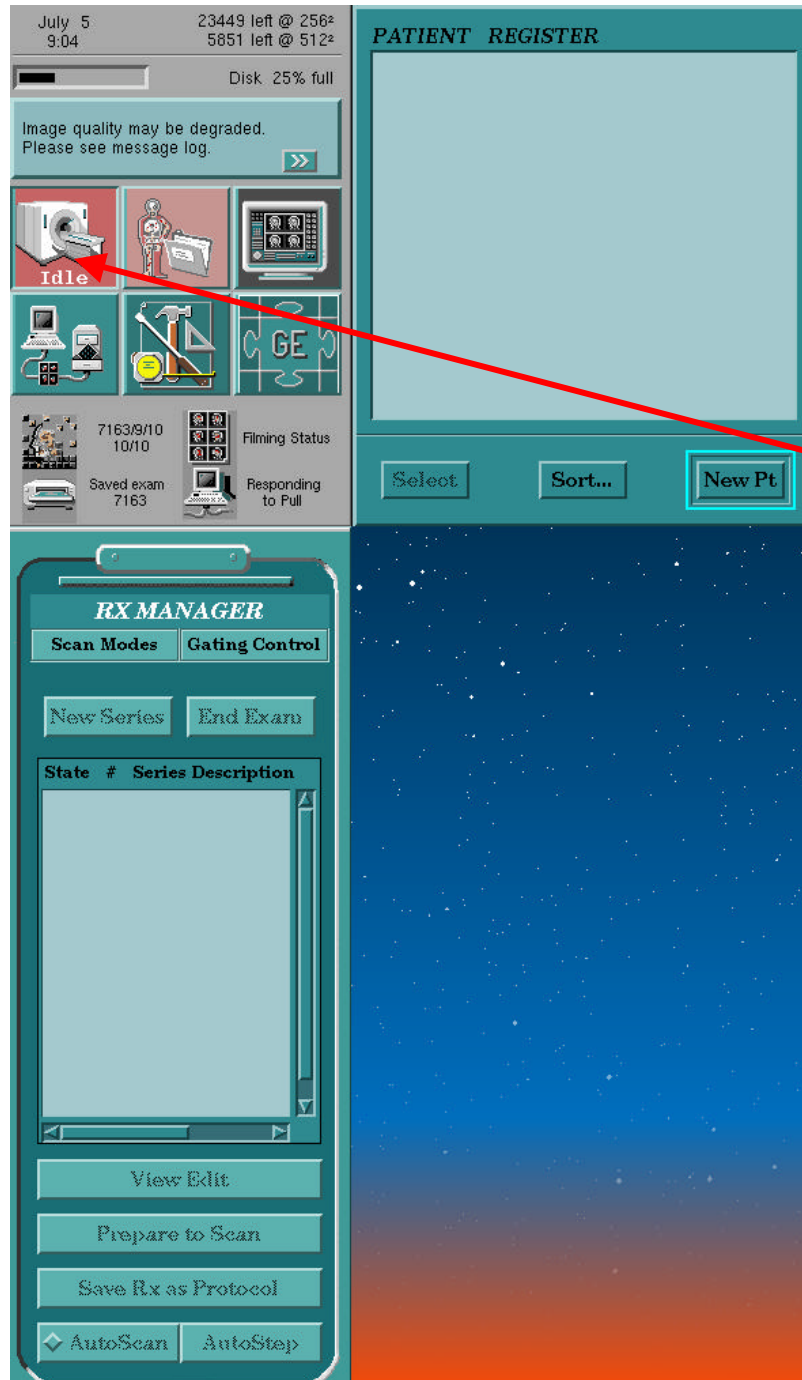
*“Internal Software
Error” ...*

Must reset TPS!

Specific Icon Functions and Uses



- Date and Time
- Informix space
- Message Board
- Scanner Operations
 - Patient Information
 - Protocol RX
- Protocol Manager
- Browser
- Network
- Tools
- Piece of the Puzzle



Scan Operations - Step 1

- Click on the Scan Operations Icon

- “Idle”

Scan Ops – Patient Register



- Click on:
New Patient

Do NOT type in the
Patient Register
“white area”

Scan Ops – Patient Information

PATIENT INFORMATION

Accession Number

Patient ID

Patient Name

Birth Date Age

Sex Weight Lb Kg

Rad Refer

Operator Status

Exam Description

History

- Click in the Patient ID Window
- Type in the MIS number
Hit **Enter**
- Do NOT use the Accession Number for the 3T Scanners
 - Prefer not all Caps
 - Prefer not all Lower Case

Scan Ops – Phantom Information

PATIENT INFORMATION

Accession Number			
Patient ID	12-12-12-1		
Patient Name	Phantom_Noise Test		
Birth Date		Age	50
Sex		Weight	180 Lb Kg
Rad		Refer	
Operator	xyz	Status	None
Exam Description	PhantomTest4Noise		
History	GE Coil		
Schedule		Landmark	

- Click in the Patient ID Window
- the **Date (and variations)** is reserved for the QA studies
- Please use numbers e.g. 12-12-12-1
- Hit **Enter**
- Type in the necessary information
 - Use an adult weight

Patient Information

PATIENT INFORMATION

Accession Number

Patient ID

Patient Name

Birth Date Age

Sex Weight Lb Kg

Rad Refer

Operator Status

Exam Description

History

This information is considered legal documentation

❖ The name as in MIS

- The patient ID equals the MIS number (separated by a dash)

Patient Information_Name

PATIENT INFORMATION

Accession Number			
Patient ID	00-00-00-0		
Patient Name	LastName, FirstName MI		
Birth Date	01/14/1967	Age	35
Sex	M	Weight	189 Lb 86 Kg
Rad	Neuro	Refer	VanBoven
Operator	xyz	Status	Out <input type="checkbox"/>
Exam Description	fMRI/TactileRspnse/6'		
History	NV/GE Coil/01-M-0173		
<input type="button" value="Schedule"/>		<input type="button" value="Landmark"/>	

This information is considered legal documentation

- The patient ID equals the MIS number (separated by a dash)
- The **full** and **legal** name as listed in the MIS system
 - Must be spelled correctly
 - No way to correct after download
 - Last Name, First Name MI
 - No name abbreviations e.g.,
 - Pete for Peter, Dan for Daniel

Patient Information_Other Information

PATIENT INFORMATION

Accession Number			
Patient ID	00-00-00-0		
Patient Name	LastName, FirstName MI		
Birth Date	01/14/1967	Age	35
Sex	M	Weight	189 Lb 86 Kg
Rad	Neuro	Refer	VanBoven
Operator	xyz	Status	Out <input type="checkbox"/>
Exam Description	fMRI/TactileRspnse/6'		
History	NV/GE Coil/01-M-0173		
<input type="button" value="Schedule"/>		<input type="button" value="Landmark"/>	

- *Birth Date:*
 - enter the correct date or the actual age
- *Weight:*
 - enter in Lbs or Kgs
- *Rad (Radiologist)*
 - enter Neuro
- *Refer:*
 - The referring physician
- *Operator:*
 - The scan operator's initials
- *Status:*
 - Using RMB
 - In (in-patient)
 - Out (out-patient)

Patient Information

PATIENT INFORMATION

Accession Number

Patient ID

Patient Name

Birth Date Age

Sex Weight Lb Kg

Rad Refer

Operator Status


Exam Description


History


- *Exam Description:*
 - what type of exam be performed
 - adding the height allows for calculation of BSA
- *History:*
 - Brief patient HX
 - Coil type
 - Scanning IRB protocol #

Scan Ops – Patient Position

PATIENT POSITION



Patient Position 


Patient Entry 


Coil 

Series Description


IMAGING PARAMETERS

Plane  Mode 

Pulse Seq 

Imaging Options 

Psd Name STL %

Protocol 

- Click on Patient Position
- Click on the drop down menu
 - Supine
 - Prone
 - Right Decubitus
 - Left Decubitus

Patient Position – Patient Entry

PATIENT POSITION

Patient Position:

Patient Entry: ←

Coil:

Series Description:


IMAGING PARAMETERS

Plane: Mode:

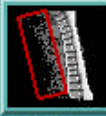



Pulse Seq:





Imaging Options:

Psd Name: STL: %

Protocol: 

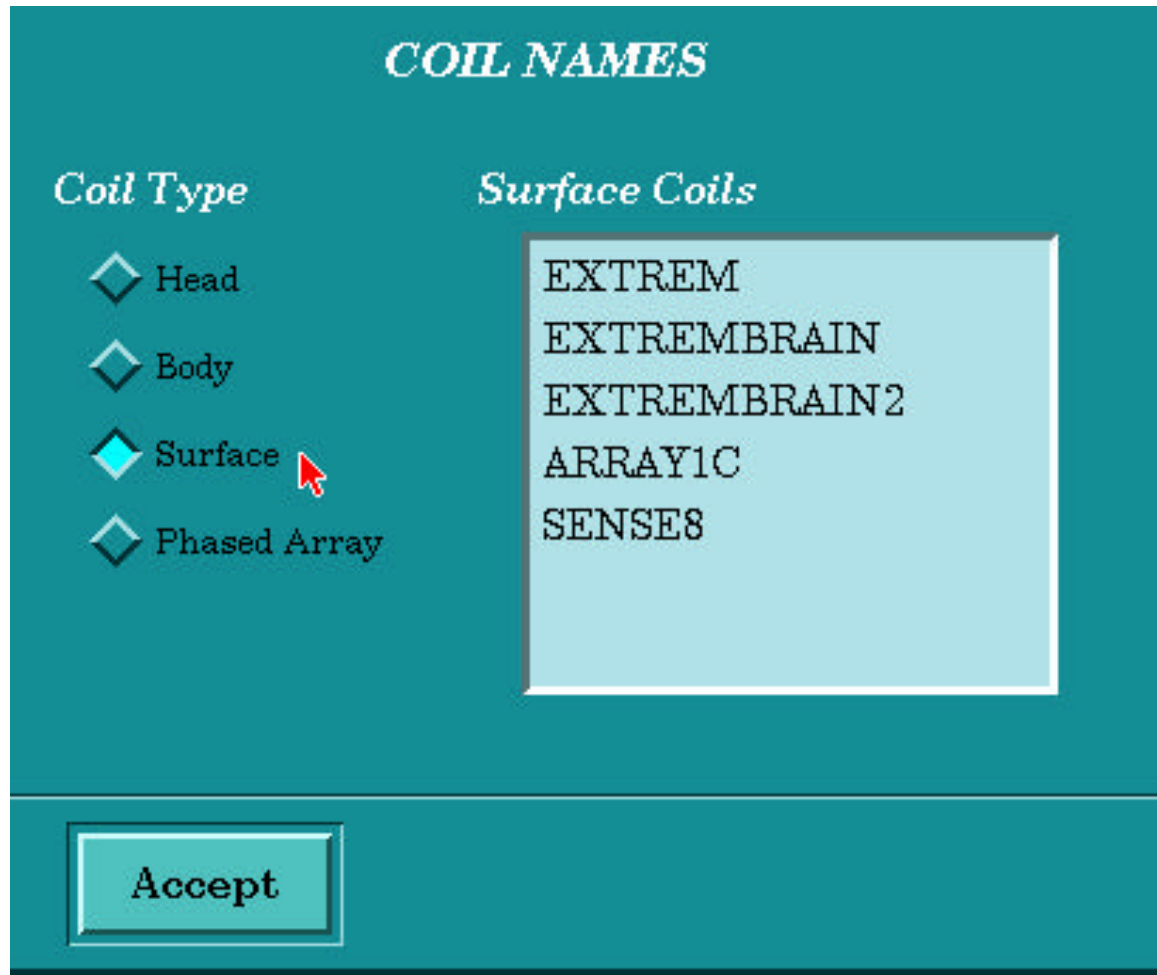
ADDITIONAL PARAMETERS

 SAT  Graphic Rx  Vascular Screen  User CVs Screen

 Gating/Triggering  Cine Screen  Multi Phase Screen  DWI Screen

- Patient Entry
 - Head First
 - Feet First
- **Important** because data/images will be marked incorrectly
 - Inferior for Superior
 - Right for Left
 - Posterior for Anterior

Coil Selection



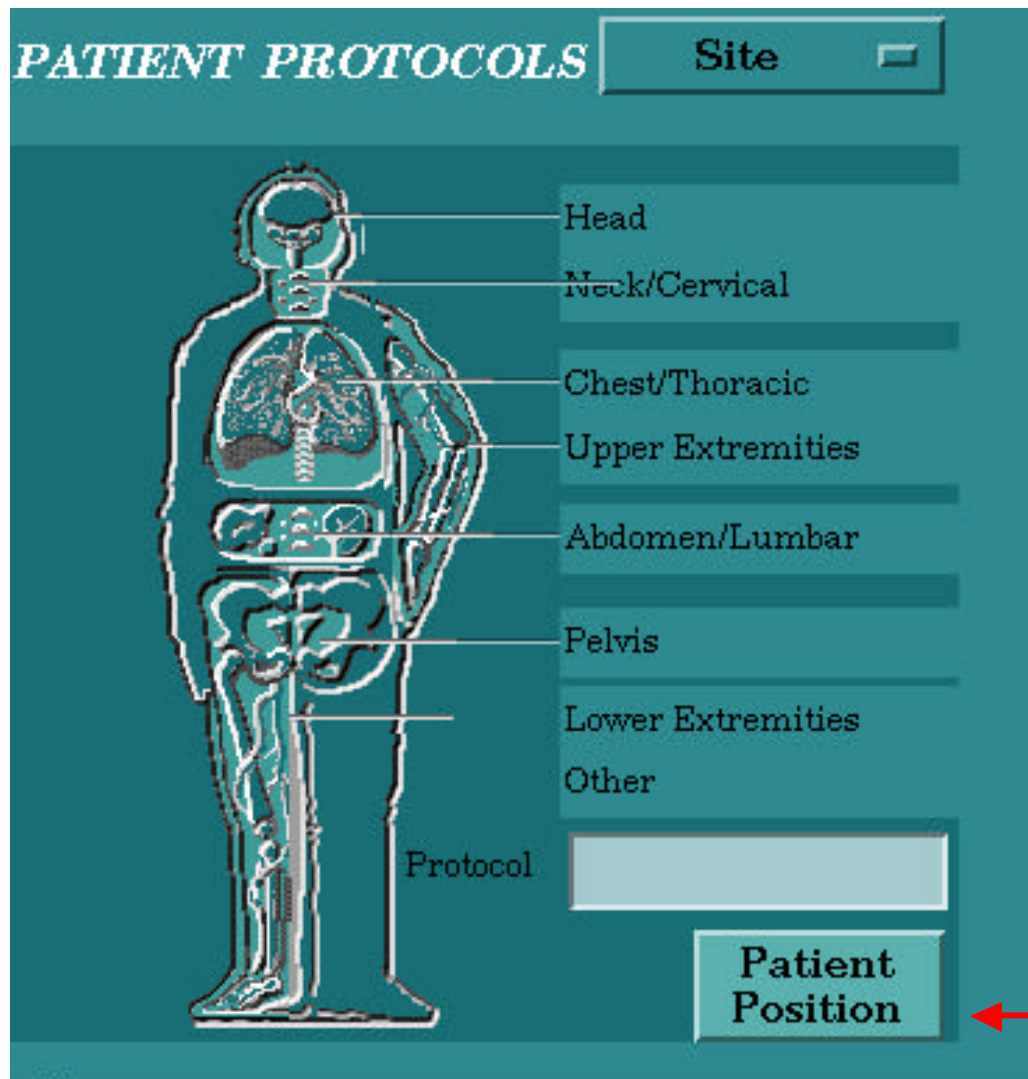
- Click (lmb) on the correct **coil type** and **coil name**
 - (if necessary)

e.g.

Surface Coil

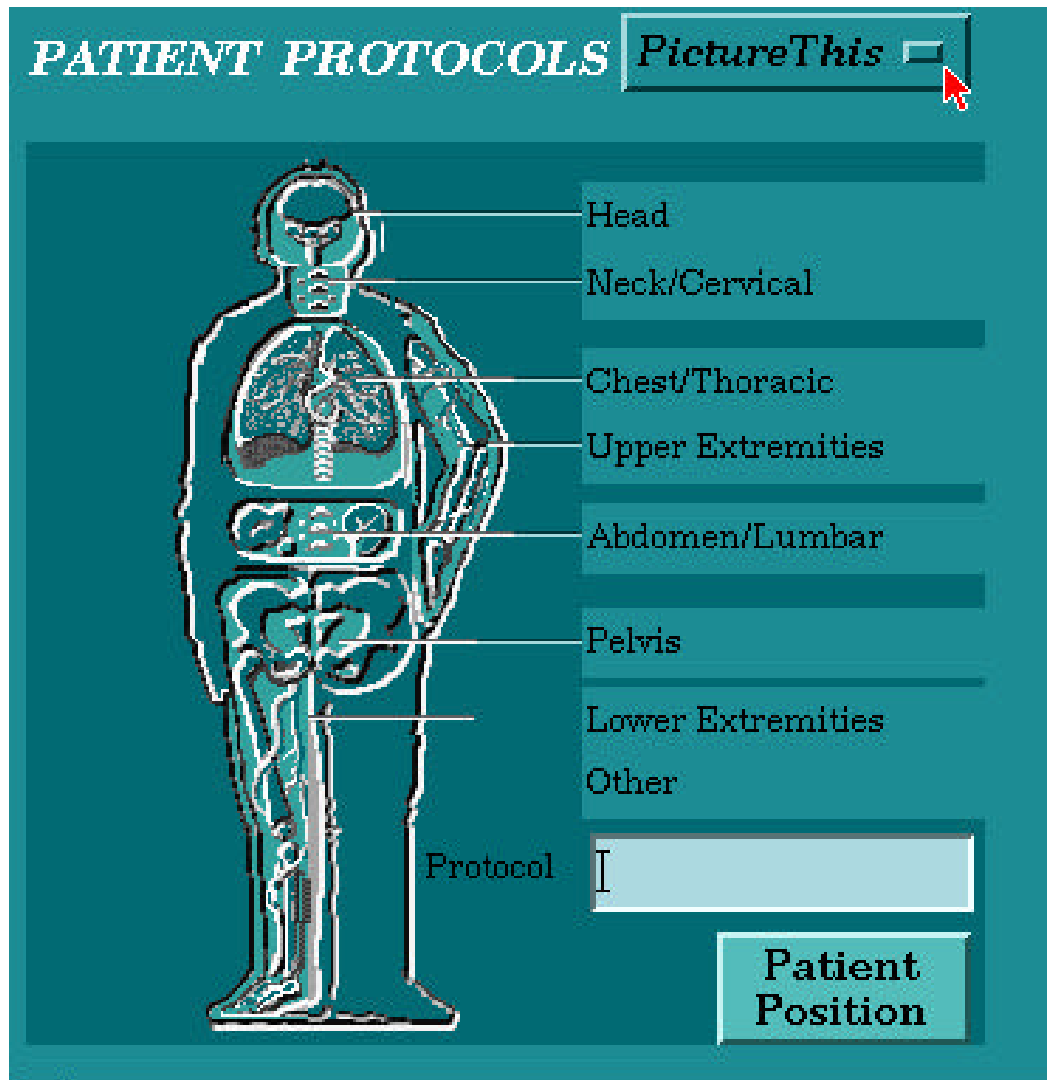
– Sense8

Patient Protocol Window



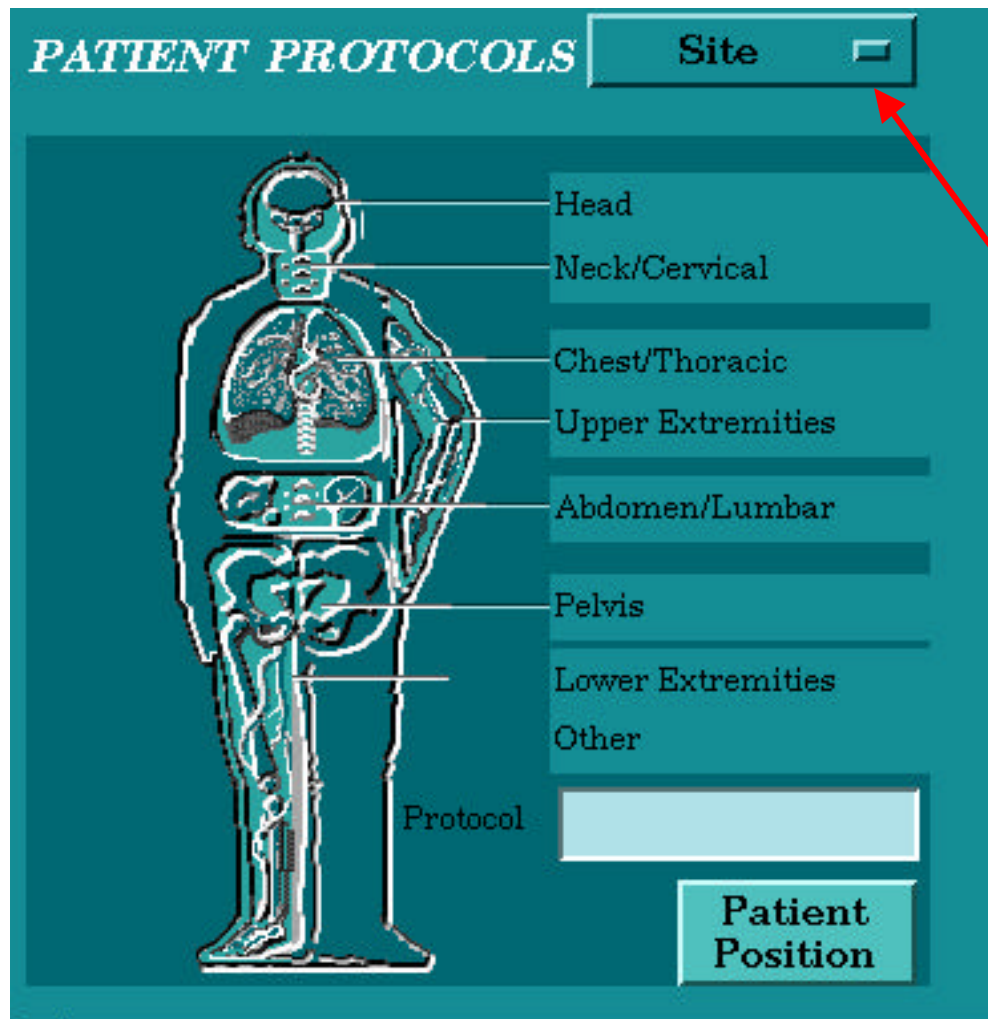
- Use pre-saved protocols from the anatomy “cookbook”
- Build protocols from scratch using the *Patient Position* button

Patient Protocols_Picture This



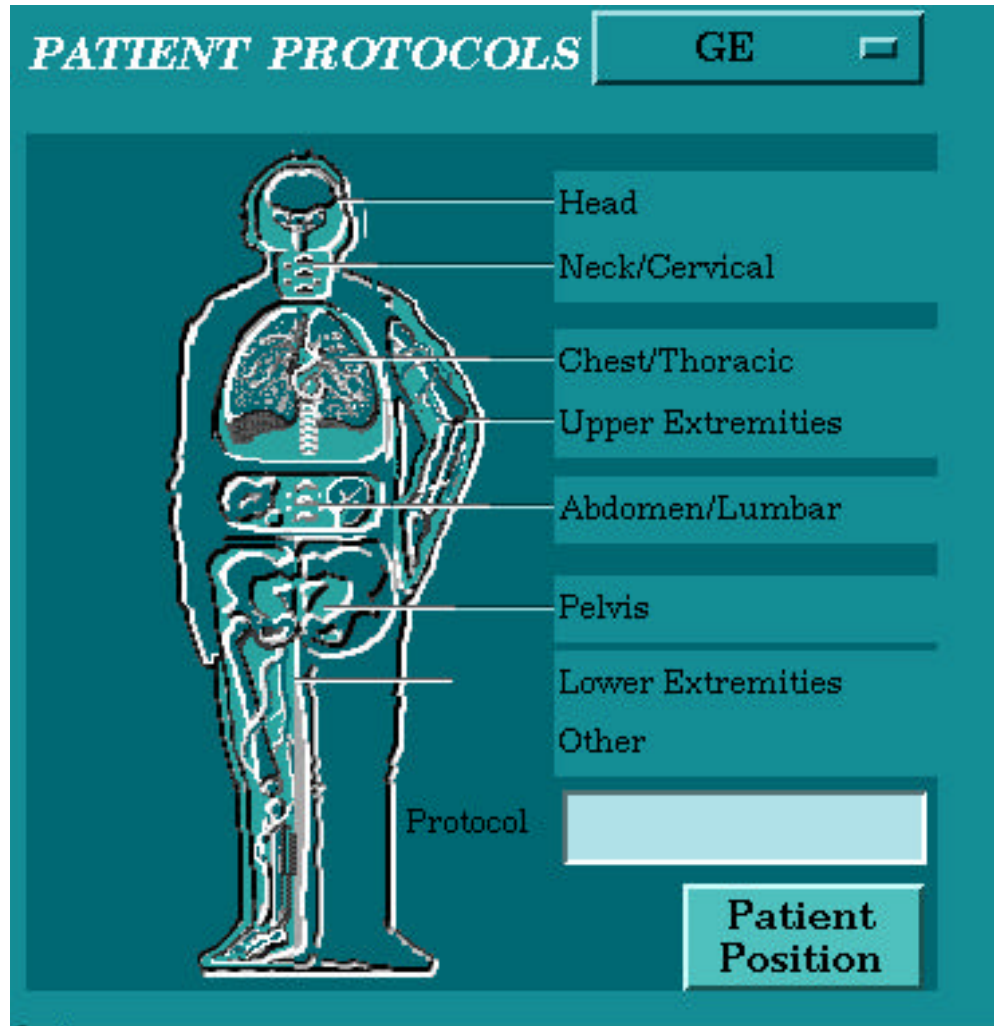
- *Picture This* is the default setting after a scanner shutdown
- Point to a Body Part for for specific protocol
 - (not the same as pre-saved Site protocols)

Patient Protocols_Site



- Specific Protocols that were developed and saved “on site”
- Site
 - The saved protocols from “our” 3T Users
 - QA_Daily Phantom
 - MR Venogram
 - Dpine_Adolescent Study

Patient Protocols_GE



- Protocols GE pre-loaded
- Listed by body part and type e.g.
 - Head, Vascular
 - Head, MS with Contrast
 - Etc.

Scan Operations Page

July 5 7:04 21065 let @ 256 5258 let @ 512

Image quality may be degraded. Please see message log.

716210 30 7157

Start Delay: 7157

Finishing Status

Network Status

PATIENT INFORMATION

Accession Number:

Patient ID: 07-05-2003

Patient Name: QA_Daily Phantom

Landmark:

Full Info

PATIENT POSITION

Patient Position:

Patient Entry:

Coil: HEAD

Series Description: 3-Plane Brain Localizer

IMAGING PARAMETERS

Plane: 3-Plane Mode: 2D

Pulse Seq: Localizer

Imaging Options: MPW

Pat Name: STL 66 %

Protocol: eudQA_Daily JBEP HHSRHS

AUTOVIEW

00.apline_noise

LOC: 716210

TE: 1.77s

TR: 11.34s

FOV: 240x240

U = 1279 L = 639

Autoview Report Cursor Update

Auto W/L Save W/L Maximize

RX MANAGER

Scan Modes Gating Control

New Series End Exam

State	#	Series Description
NEW	3-Plane Brain	
NEW	Axial jbp	
NEW	Sagittal jbp	
NEW	Coronal jbp	

View Edit

Prepare to Scan

Save Rx as Protocol

AutoScan AutoStep

SCAN TIMING

# of Echoes	Min.	Max.
TE	1.0	1.0
TSE	20.0	300.0
T1	8	6000
T2	10	4000
T2*	50	4000
Flip Angle	1	170
Kilo Zwin Length		
Scan Width	0.0	31.2
Scan Length	0.0	340.0

ADDITIONAL PARAMETERS

SAT Gradient Vascular MRA CTA

Triggering Core Sub ECHO T1

ACQUISITION TIMING

Freq: 258 Freq Dth

Phase: 128 Auto Center Freq Water

HEX: 2.00 Raw Data Direction

Phase: 10V AutoSpin Phase Contrast

of Angles Echoes Pulse

Agel

SCANNING RANGE

POV: 00 Min: 4 Max: 40

Slice Thickness: 4.0

Spacing: 1.0

R/L A/P S/I

Center of POV: 0.0 0.0 0.0

Slices Per Plane: 1 Table Delta: 0.00

Rx Scan Time: 0:08

Save Series

Drive FPS: 1

Est. SAR: 0.0036

Ref. SNR(%): 100

Average Head SAR: 0.0939

Max # of Shots/Angle: 1

Peak SAR: 0.2096

of Angles: 3

Reset Values

- The way it looks after the Patient information is entered
- and*
- After a “Cookbook” protocol has been selected

Scan Ops - Scan Timing

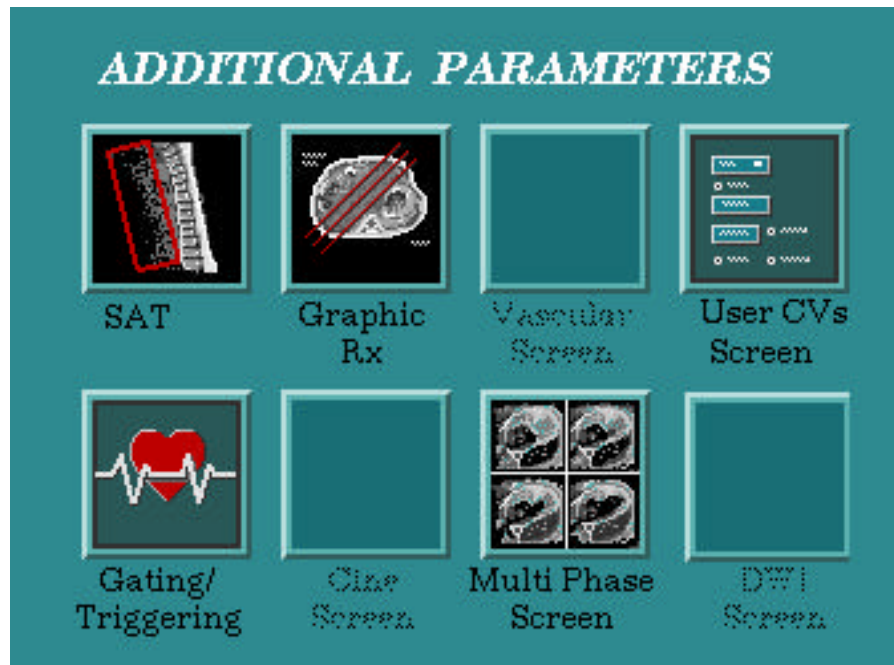
The screenshot displays a medical imaging console interface with the following sections:

- PATIENT INFORMATION:** Accession Number, Patient ID (07-05-2002), Patient Name (QA_Daily Phantom).
- PATIENT POSITION:** Patient Position (Supine), Patient Entry (Head First), Coil (HEAD), Section Description (3-Plane Brain Localizer).
- AUTOVIEW:** A circular image of a brain scan with technical details like LOC/20, TRIP, TE1L/7Fr, ETL/1 3L/2ME, FOV:24x24, H = 1279 L = 639.
- IMAGING PARAMETERS:** Plane (3-Plane), Mode (2D), Pulse Seq (Localizer), Imaging Options (MPW), Pad Name (STL 06 6), Protocol (ea/QA_Daily/BEPI/ HDSR DS).
- SCAN TIMING:** A table of timing parameters for different sequences.

	Min.	Max.
# of Echoes	1.0	1.0
TE	1.8	11.0
TE1	20.0	2000.0
TE2	6	6000
TE3	10	4000
TE4	50	4000
Flip Angle	1	170
Echo Train Length		
Desired width	0.0	31.2
Readout delay	0.0	34000
- ADDITIONAL PARAMETERS:** Buttons for BAT, Graphical BA, Variable Refresh, Non-DV's Refresh, Gradient Trimming, Class Refresh, Main Filter Refresh, DFI Refresh.
- ACQUISITION TIMING:** Preset (256), Preset 24 A, Phase (128), Auto Center Preset, Water, HSE (2.00), Flow Comp, Dose Rate, Phase (90), Autoshim, Phase Contrast, Contrast, A/C, # of Acqs Before Pause, Signal.
- SCANNING RANGE:** Min. 4, Max. 48, FOV (24), Slice Thickness (4.0), Spacing (1.0), Center of POV (0.0, 0.0, 0.0), # Slices Per Plane (1), Table Delta (0.00).
- Bottom Bar:** Rx Scan Times (0:09), Rel. SNR (%) (100), Max # of Slices / Acq (1), Save Series, IDW/FPS (1), Est. SAR (0.0036), Average Head SAR (0.0339), Peak SAR (0.2089), # of Acqs (3), Reset Values.

- Ready for input:
- Scan Timing
 - TR, TE, Flip, ETL, BW
- Additional Parameters
 - Sat, GRx, CV's etc
- Acquisition Timing
 - Matrix, Nex etc
- Scanning Range
 - FOV
 - Slice thickness
 - Slice spacing
- Save Series

Scan Ops – Additional Parameters



- Ready for the next steps
 - SAT
 - Graphic RX
 - Vascular Screen
 - User CVs
 - ECG
 - CINE
 - Multi-phase
 - DWI Screen

Scan Ops – Scanning Range

SCANNING RANGE

		Min.	Max.		S / I	L/R Center	P/A Center
FOV	24	8	99	Start		0.0	0.0
Slice Thickness	5.0			End			
Spacing	5.0			# Slices		Table Delta	0.00
				Actual End			

- Type or click drop-down menu
 - FOV
 - Slice Thickness
 - Scan Spacing
- Type-in or use Grx RX option
 - S/I
 - L/R
 - P/A

ScanOps - Acquisition Timing

ACQUISITION TIMING

Freq	256	>	Freq DIR	R/L	>
Phase	192	>	Auto Center Freq	Water	>
NEX	1.00	>	Flow Comp Direction		>
Phase FOV	1.00	>	<input checked="" type="checkbox"/> Autoshim	<input type="checkbox"/> Phase Correct	
			<input type="checkbox"/> Contrast	Amnt	
# of Locs Before Pause		>	Agexl		

- Click on drop down menus
 - Freq Direction(X)
 - Phase Direction (Y)
- NEX
- Phase FOV
- Freq DIR
 - SPF
- Center Freq on Water
- AutoShim
- Phase Correct
- Contrast
- # of locs before pause
 - Breath-holds

Acquisition Timing + Contrast

ACQUISITION TIMING

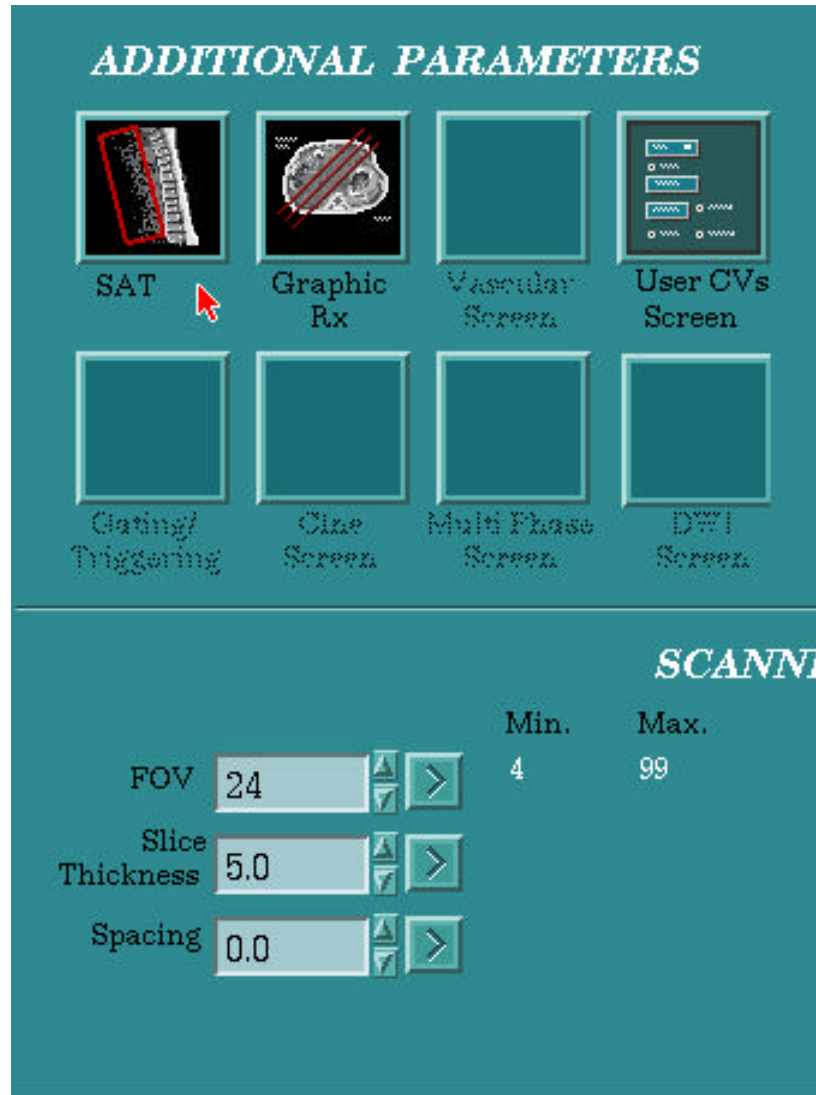
Freq	256	>	Freq DIR	R/L	>
Phase	192	>	Auto Center Freq	Water	>
NEX	1.00	>	Flow Comp Direction		>
Phase FOV	1.00	>	<input checked="" type="checkbox"/> Autoshim	<input type="checkbox"/> Phase Correct	
			<input checked="" type="checkbox"/> Contrast Amnt	20ml	
# of Locks Before Pause		>	Agent	Gd-DTPA	

- Click on Contrast
 - Type in amount to be given
 - Type in the Agent

Using Fat Sat Suppression

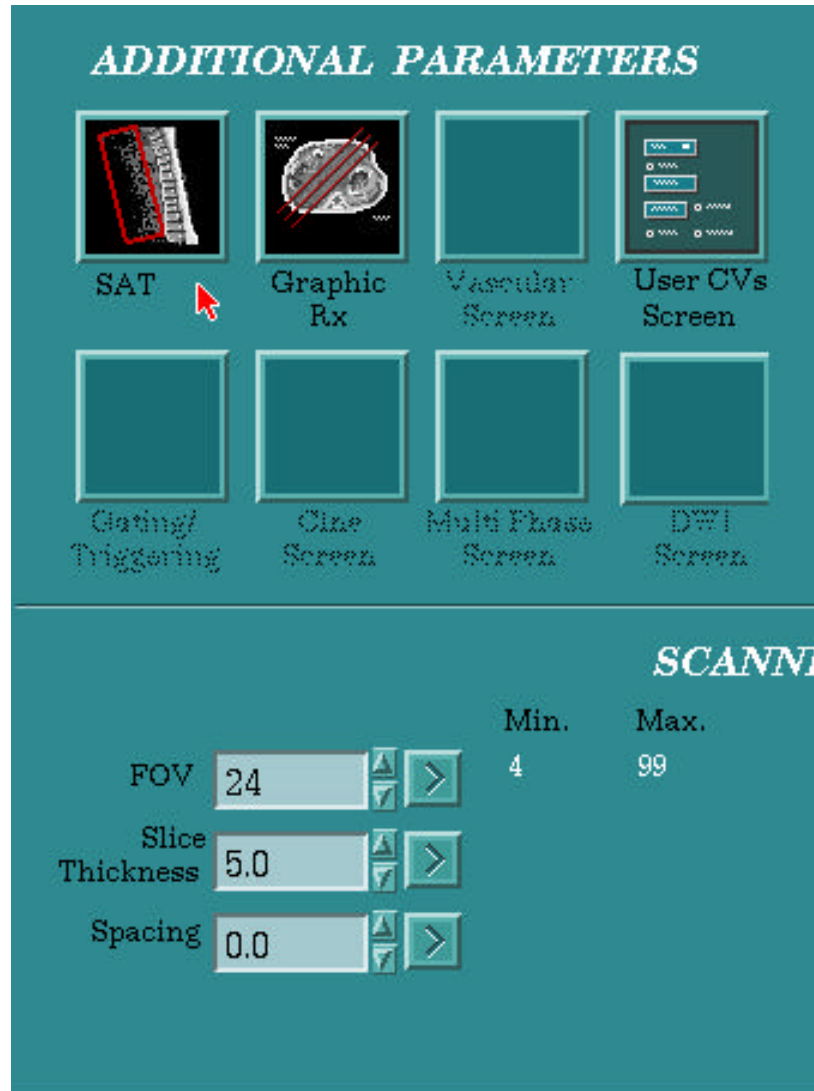
- GE AutoShim
 - Click on AutoShim in the Acq Timing Window
- High Order Shim
 - Use the EPI Scan Locations
 - ShimCalc
 - Do not move table

Adding A Sat Band (AKA Fat Sat)



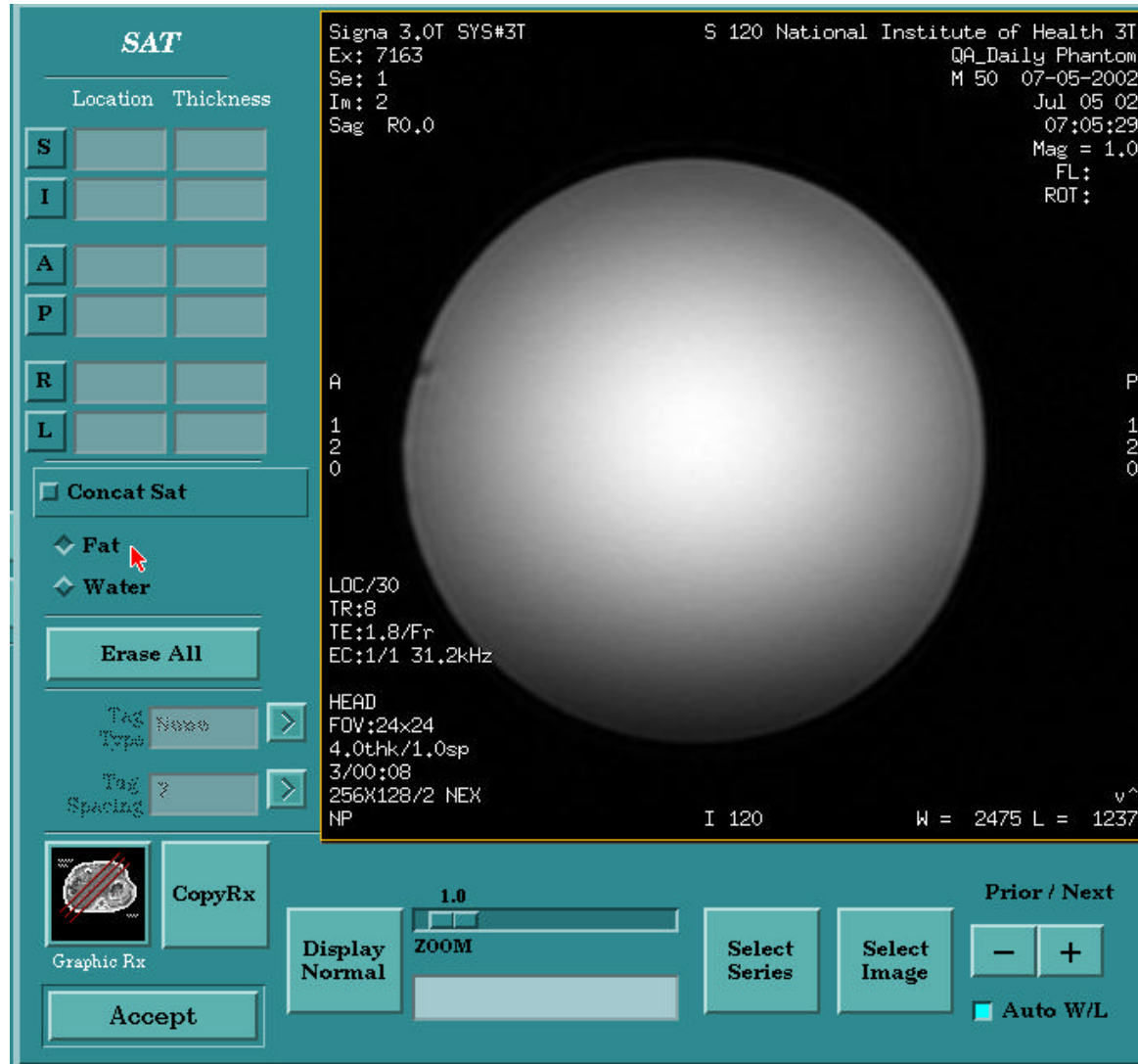
- In the Additional Parameters Window of Scan Operations Page
 - Click on the **SAT** icon

Using Fat Sat_Step 1



- Click on the SAT icon
 - (after typing in scan locations or using the GrxRX option)
 - Located in the Additional Parameters Area

Using Fat Sat - Step 2



- Click on **Fat** in the SAT window
 - * Click On and Off and then ON (* Tech Trick)
 - Click **Accept**

Using Fat Sat – Check Offset

Display CVs

CV Names

off_rfcssat	CV Name :	off_rfcssat
off_rfse1	Type :	Integer
off_rfse2	Current Value :	-440
off_rfse3	Minimum :	-2147483647
off_rfse4	Maximum :	2147483647
off_rfse5	Comment :	
off_rfse6		
off_rfsx1		
off_rfsx2		
off_rfsy1		
off_rfsy2		
off_rfsz1		
off_rfsz2		
off_thetarfl		
opacqo		
opadvgate		
opapcsiis		
opapflow		
oparr		

Accept

- Research Options
- Display CV's (rmb):
 - After series download
 - Do not confuse with User CV
- Type in value:
 - off_rfcssat*
 - - 440 (@ 3 T)
 - - 220 (@ 1.5 T)
- Use rmb and click on Download
 - Click on *Accept*

Using Fat Sat - jbEPI Option-Step 1

Display CVs

CV Names

off_rfcssat	CV Name :	off_rfcssat
off_rfse1	Type :	Integer
off_rfse2	Current Value :	-440
off_rfse3	Minimum :	-2147483647
off_rfse4	Maximum :	2147483647
off_rfse5	Comment :	
off_rfse6		
off_rfsx1		
off_rfsx2		
off_rfsy1		
off_rfsy2		
off_rfsz1		
off_rfsz2		
off_thetarfl		
opacqo		
opadvgate		
opapcsiis		
opapflow		
oparr		

Accept

- jbEPI (NIH EPI)
- Research Options Display CV's (rmb):
 - After series download
 - Do not confuse with User CV
- Type in value:
off_rfcssat
 - 440 (@ 3 T)
 - 220 (@ 1.5 T)

Using Fat Sat - jbEPI Option-Step 2

Display CVs

CV Names

- opsat
- opsatmask
- opsatx
- opsatxloc1
- opsatxloc2
- opsatxthick
- opsaty
- opsatyloc1
- opsatyloc2
- opsatythick
- opsatz
- opsatzloc1
- opsatzloc2
- opsatzthick
- opsavedf
- opscic
- opscsiis
- opsiflow
- opsldelay

CV Name : opsat

Type : Integer

Current Value : 1

Minimum : 0

Maximum : 1

Comment : Saturation switch; 0=off, 1=on.

Accept

This CV has been fixed. Enter 'u' or 'U' to unfix.

- jbEPI (NIH EPI)

- Turn on opsat

- 0 = off
- 1 = on

Using Fat Sat - jbEPI Option-Step 3

Display CVs

CV Names

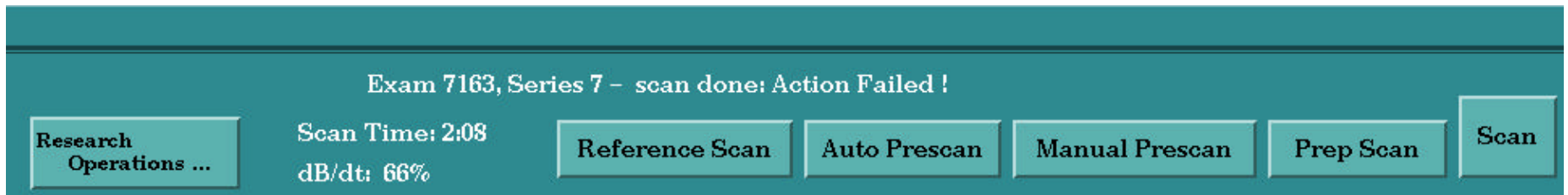
opfat	CV Name :	opfat
opfcaxis	Type :	Integer
opfcine	Current Value :	1
opfcomp	Minimum :	0
opflair	Maximum :	1
opflaxall	Comment :	Fat pre-saturation: 0=off, 1=on.
opflaxx		
opflaxy		
opflaxz		
opflip		
opflrecon		
opfov		
opfphases		
opfreqfov		
opfulltrain		
opgcoil		
opgrx		
opgrxroi		
ophrate		

Accept

This CV has been fixed. Enter 'u' or 'U' to unfix.

- jbEPI (NIH EPI)
- Turn on **opfat**
 - 0 = off
 - 1 = on
- Use rmb and click **Download**
- Click on **Accept**

GE Real Time EPI Error Message with the Fat Sat Option



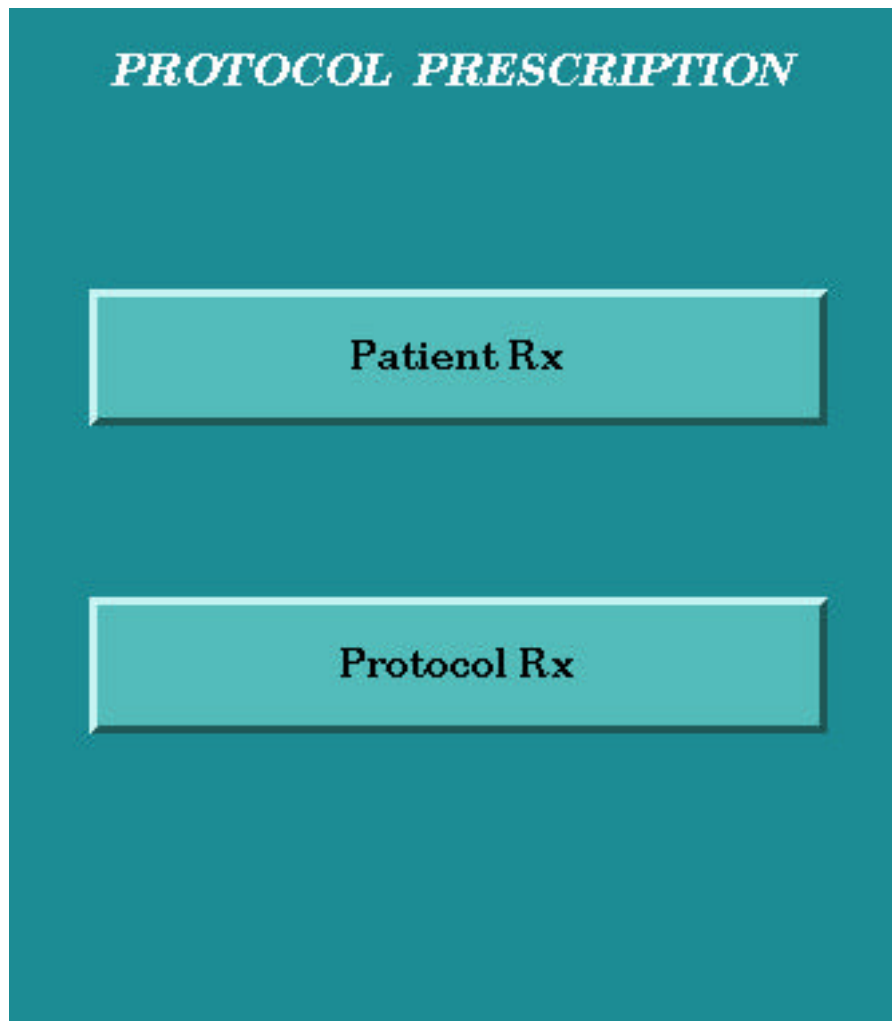
- Typical error message when using GE RT
 - May be indicating to check Fat Sat status
 - (normal error) Important!
 - May be real error
 - Prescan errors
 - Software error
 - Reset TPS

Specific Icon Functions and Uses



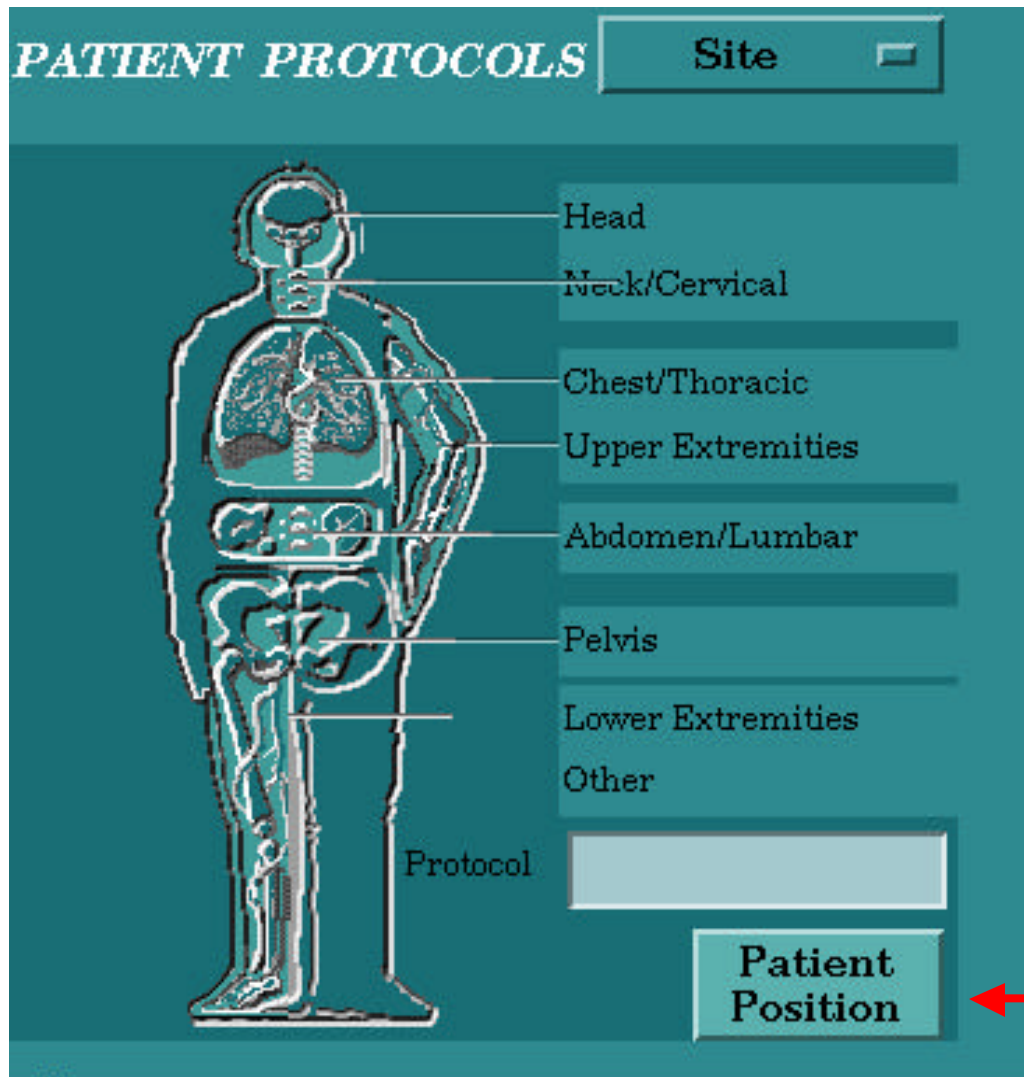
- Date and Time
- Informix space
- Message Board
- Scanner Operations
- Protocol Manager
 - MIS/RIS Connected Patient Information
 - Protocol Build/Edit
- Browser
- Network
- Tools
- Piece of the Puzzle

Protocol Prescription Window



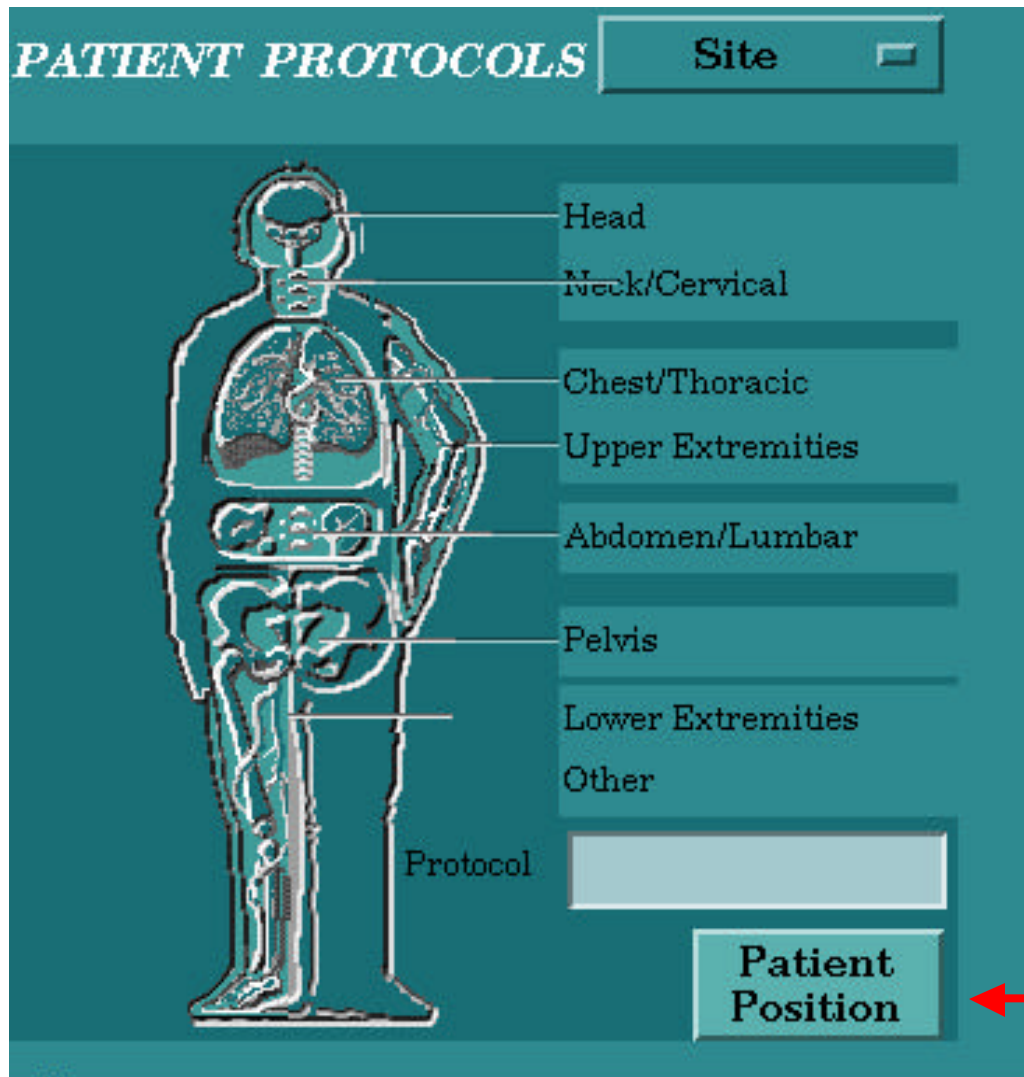
- Patient RX
 - Not applicable to the 3T
 - Mis/Ris Connections
- Protocol RX
 - Protocols can be built and saved **or** to modify a previously saved protocol

Patient Protocol Window



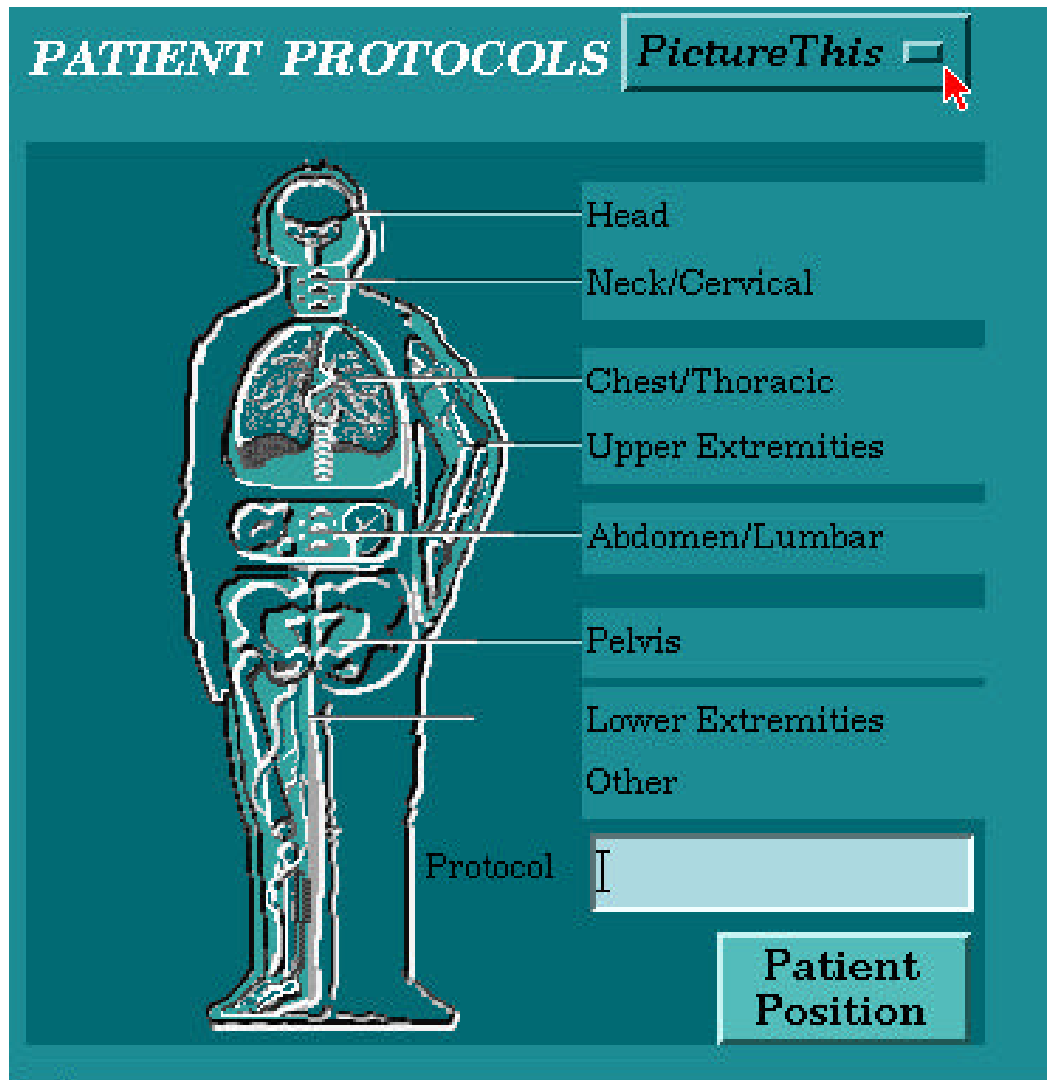
- Use pre-saved protocols from the anatomy “cookbook”
- Build protocols from scratch using the *Patient Position* button

Patient Protocol Window



- Use pre-saved protocols from the anatomy “cookbook”
- Build protocols from scratch using the *Patient Position* button

Patient Protocols_*Picture This*



- This is the default setting when the scanner has been shutdown and rebooted (not TPS reset)
- Point to a Body Part for for specific protocol
 - (not the same as pre-saved Site protocols)

Patient Protocols_*Site*

PATIENT PROTOCOLS

Site

Head

Neck/Cervical

Chest/Thoracic

Upper Extremities

Abdomen/Lumbar

Pelvis

Lower Extremities

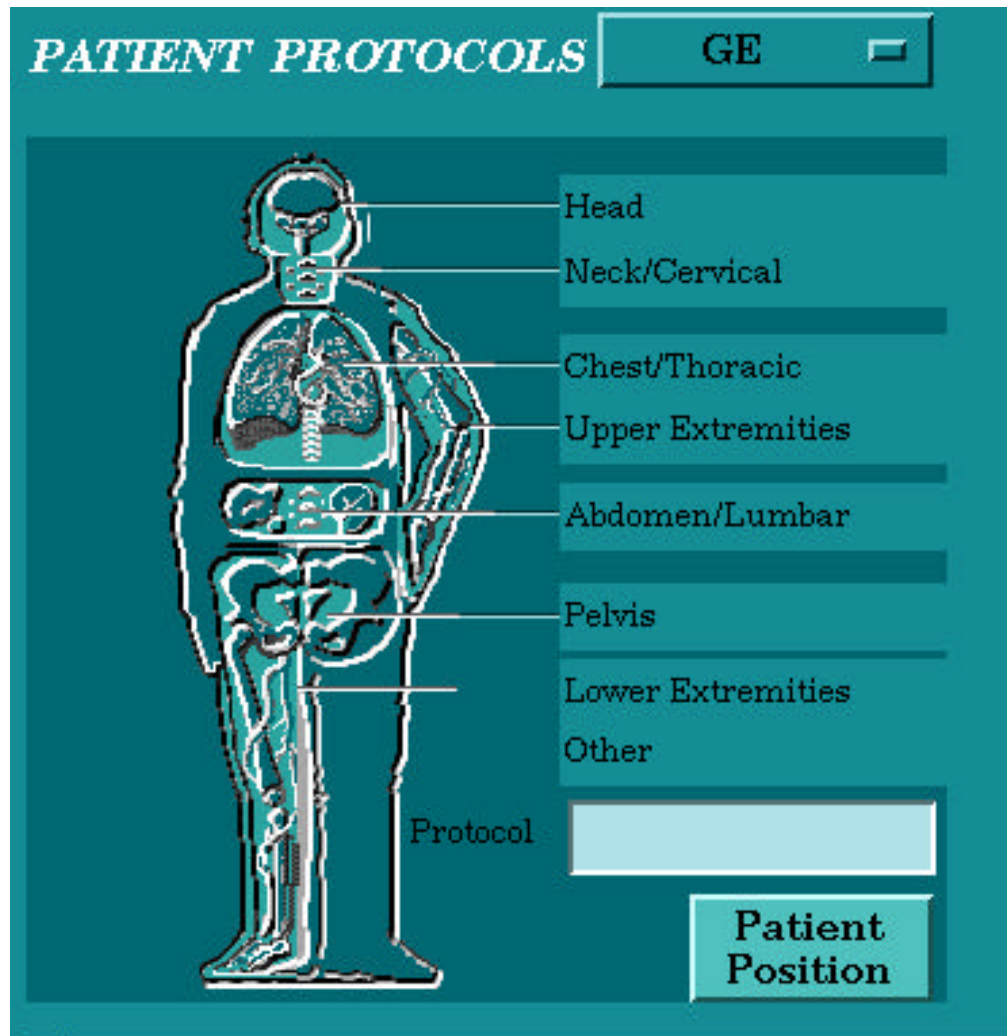
Other

Protocol

Patient Position

- Specific Protocols that were built and saved “on site”
- Site
 - The saved protocols from “our” 3T Users
 - QA_Daily Phantom
 - MR Venogram
 - Dpine_Adolescent Study
 - etc.

Patient Protocols_*GE*



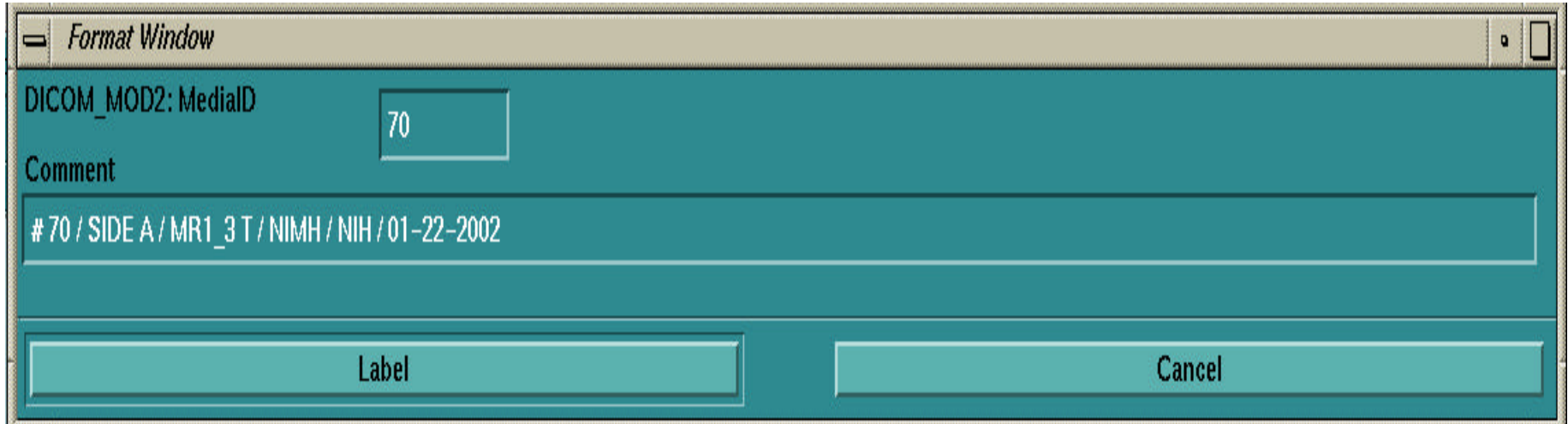
- Protocols GE pre-loaded at factory
 - Gives starting parameters
 - Not optimized for individual scanner
- Listed by body part and type e.g.
 - Head, Vascular
 - Head, MS with Contrast
 - etc.

Specific Icon Functions and Uses



- Date and Time
- Hard Drive Space
- Message Board
- Scanner Operations
- Protocol Manager
- **Browser**
 - Archive functions
 - Filming functions
 - Network (local) functions
- Network
- Tools
- Piece of the Puzzle

The MOD



Format Window

DICOM_MOD2: MediaID 70

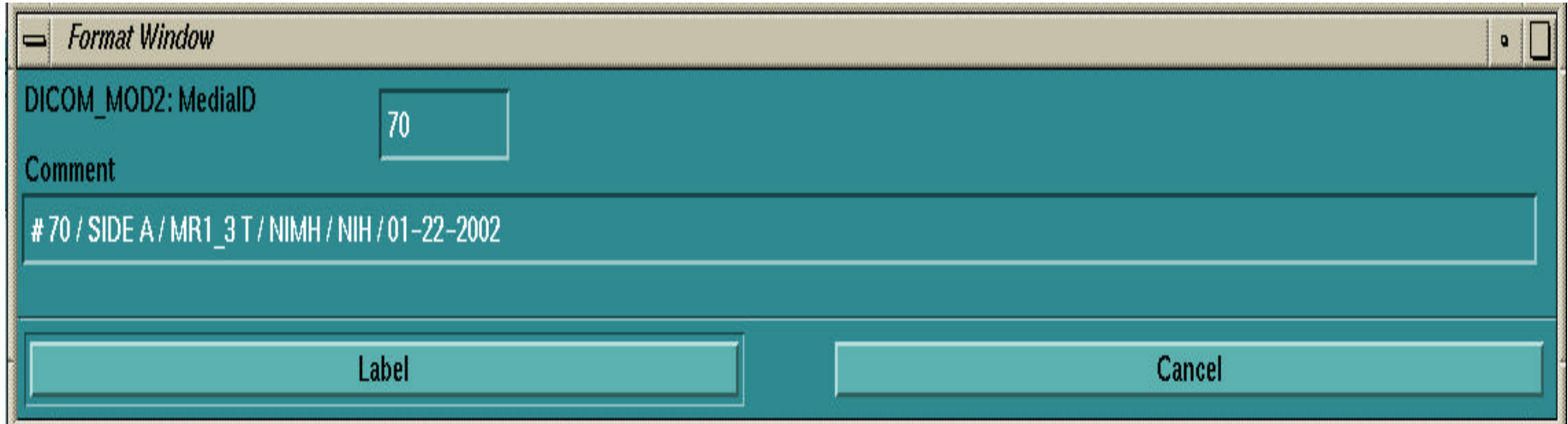
Comment

70 / SIDE A / MR1_3 T / NIMH / NIH / 01-22-2002

Label Cancel

- MOD = Magneto Optical Drive
 - Stores information via laser (light) and via the magnetic method
 - magnetically polarized digitized data (0's,1's)
 - Stores Image Data (not raw or epi files)
 - All patient/animal studies must be archived

Labelling the MOD



Format Window

DICOM_MOD2: MediaID 70

Comment

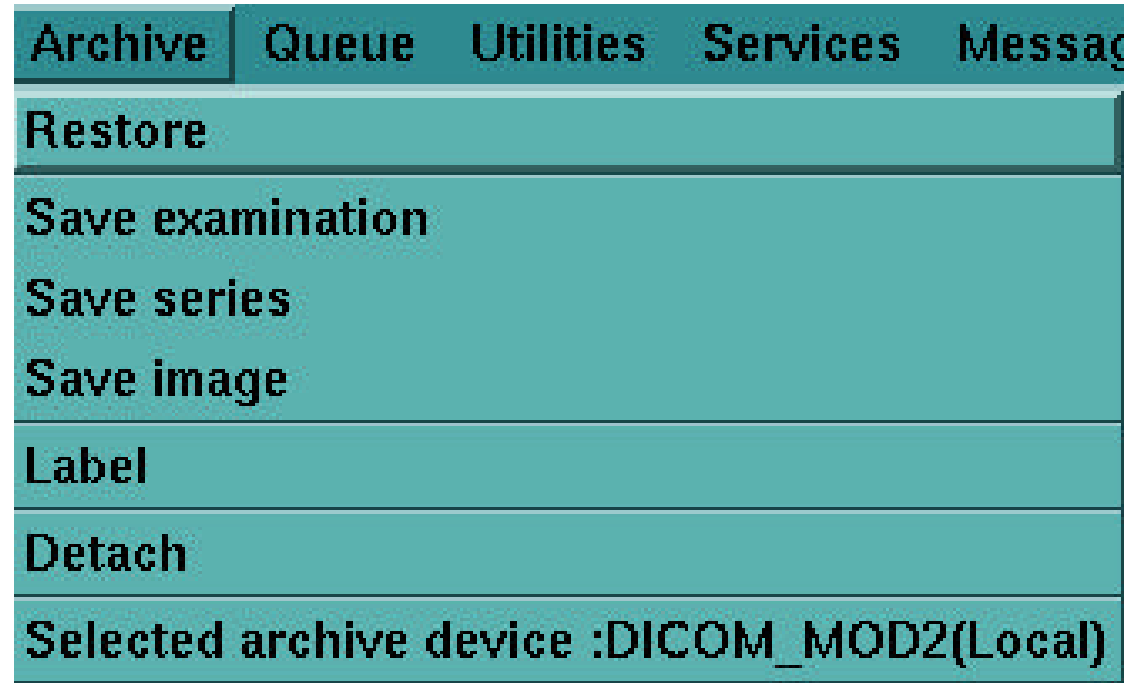
70 / SIDE A / MR1_3 T / NIMH / NIH / 01-22-2002

Label Cancel

- Click on Browser Icon
 - Click Archive
 - Click Label Disk
 - Enter the information as above
 - » Click Label

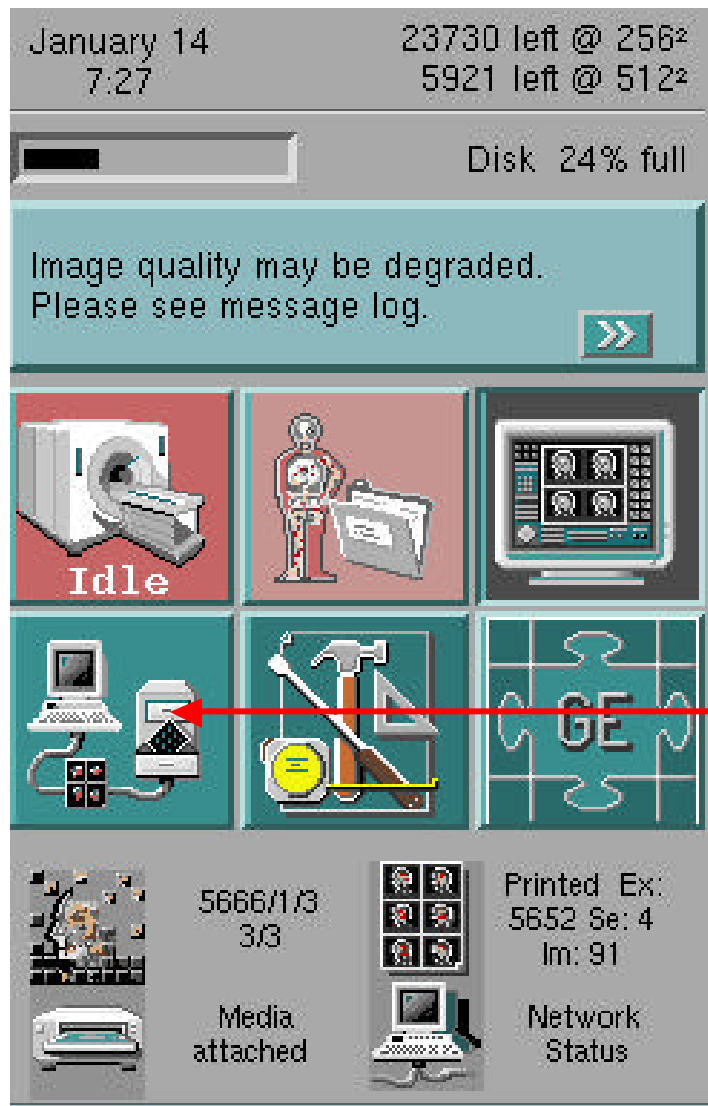
(be sure to not overwrite data on a previously labeled disk!)

Archive / Restore Procedure



- Select Browser Icon
 - Click on Archive
 - Save by Exam
 - Save by Series
 - Save by Image

Specific Icon Functions and Uses



- Date and Time
- Informix space
- Message Board
- Scanner Operations
- Protocol Manager
- Browser
- Network
 - Administrative Set-up only
 - No General User Operations
- Tools
- Piece of the Puzzle

Specific Icon Functions and Uses



- Date and Time
- Informix space
- Message Board
- Scanner Operations
- Protocol Manager
- Browser
- Network
- Tools
 - Engineer Options
 - Reset TPS
 - C Shell
 - System Shutdown
- Piece of the Puzzle

The Tools Icon Window



- Engineer Options
 - Cal/Checks
 - Utilities
 - etc.
- User Options
 - TPS Reset
 - System Shutdown
 - C Shell

The Tools Icon_TPS Reset

TPS = Transceiver Power Supply

How it works:

The experiment is running ...

The NMR signal goes to the pre-amplifier(receiver aspect) and then it goes to the UCERD, where it is digitized.

Click on TPS Reset

- TPS Reset Yes or No?
- TPS Reset in process

- When process is finished and continuing on same patient
- At the Patient Number type MR
- (most recent)

– Do not have to re-landmark!



TPS Reset + UCERD



TPS = Transceiver processing and Storage

The TPS encompasses the Array Processor + the digital aspect of receiver, etc.

- UCERD = Universal Combined Excited Receiver Digital
 - Digital Receiver board
 - Analog receiver board
 - Exciter transmit board
- Allows the same piece of hardware to be interchangeable amongst field strengths (1.5 T, 3 T, 7 T etc).
- Sometimes it is necessary to recycle power to the TPS / Systems Cabinet:
 - See Jerzy, Sean, Karen or Paula for help

The Tools Icon Window_System Shutdown

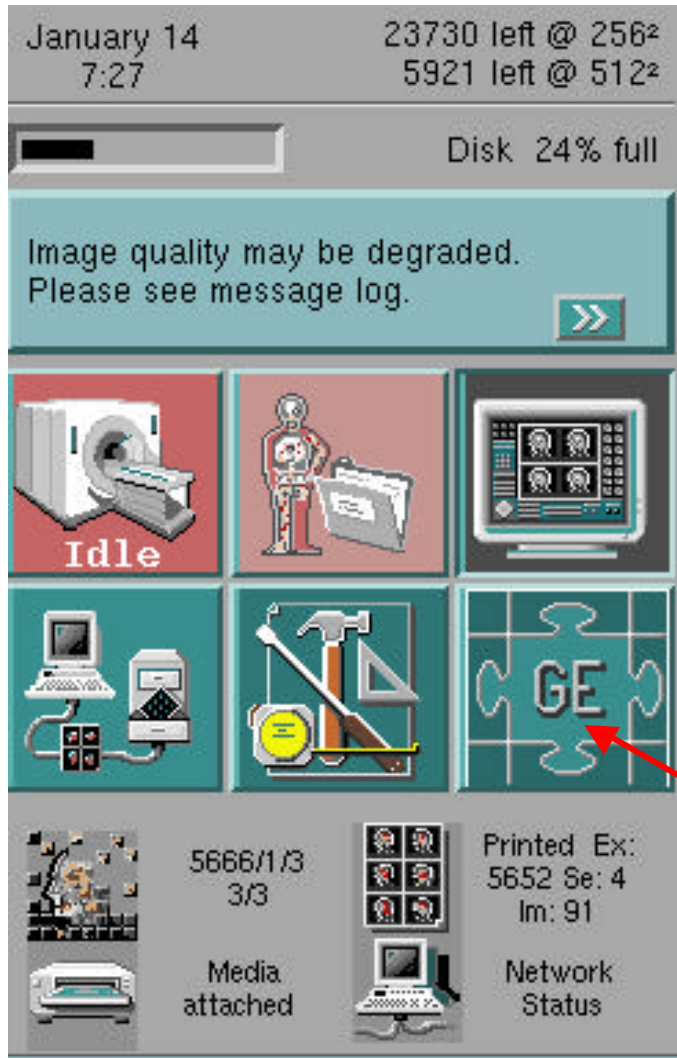


- Engineer Options
- User Options
 - TPS Reset
 - C Shell

System Shutdown

- Click on System Shutdown
 - System Shutdown
Yes or No?

Specific Icon Functions and Uses



- Date and Time
- Hard Drive Space
- Message Board
- Scanner Operations
- Protocol Manager
- Browser
- Network
- Tools
- Piece of the Puzzle
 - GE's Puzzle
 - No Operations Available (yet)

Scanning and Shimming

The Start-Up Procedure for 3T_1

- Signa Shutdown
 - Do NOT Shutdown Signa (and leave down) at night!!
- Signa Reboot
- Sun ADW shutdown to root
- Sun ADW Reboot
- Potassium shutdown to Red Hat Login Prompt
- Connect to sdc-adw

The Start-Up Procedure for 3T_1

- Shut- down the scanner
 - Tools Icon
 - System Shutdown?
 - Yes
- Reboot the scanner
 - Signa Icon
 - xxxxxx
- Bring down the SUN ADW to Root
 - At (#) prompt, type reboot
 - Root
 - xxxxxxxxx
- Bring Down Potassium to Login Prompt
 - Login at prompt:
 - sdc-adw
 - sdc-nfs

Signa DOWN Procedure

- Shut- down the scanner

Tools Icon

System Shutdown?

Yes

Wait until scanner is down

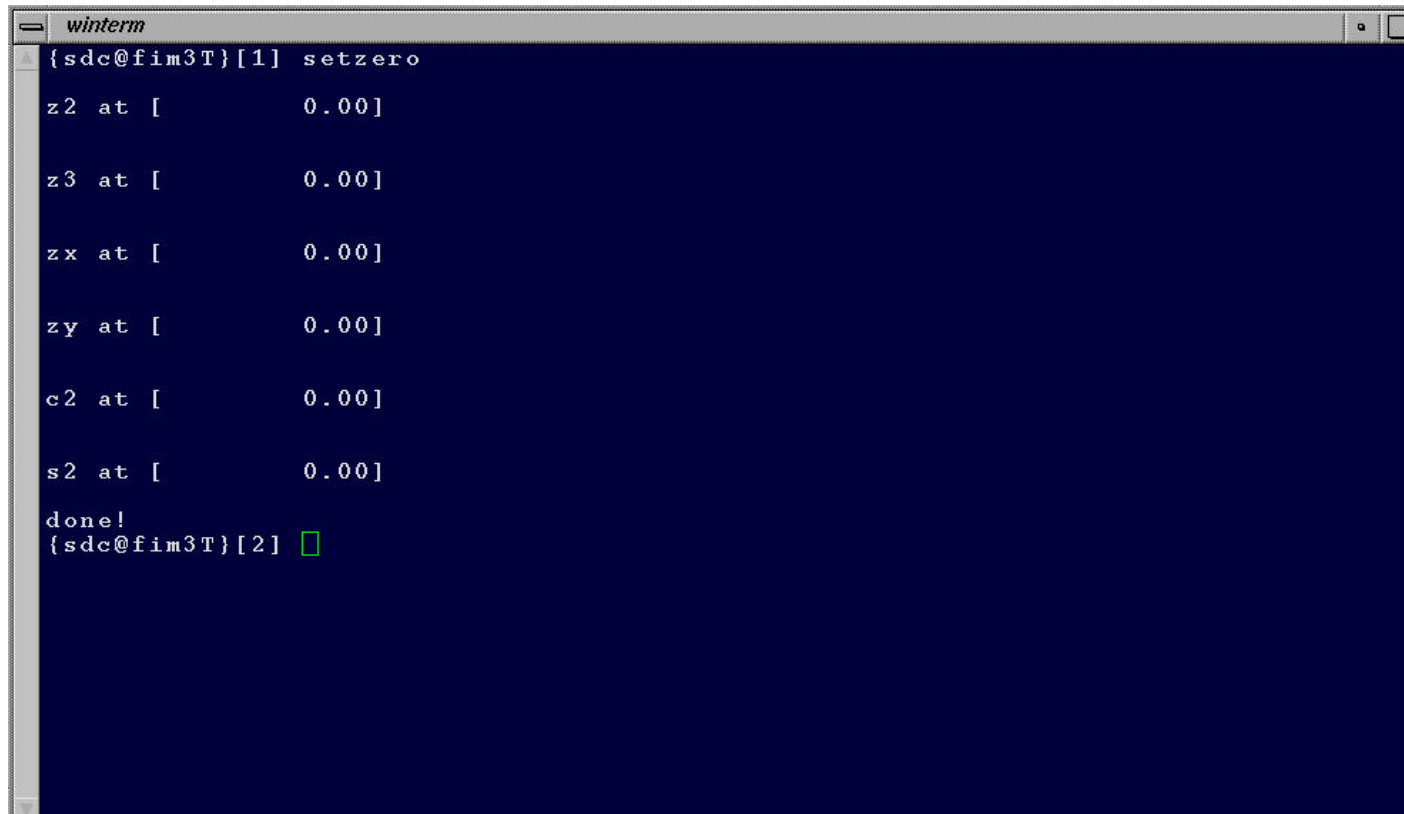
Do NOT Shutdown Signa (and leave down) at night!!

Signa UP Procedure

- Reboot the scanner
 - Signa Icon
 - xxxxxx
- Reboot SUN ADW
- Reboot Potassium

Do NOT Shutdown Signa and/or the Sun ADW
(and leave down) at night!!

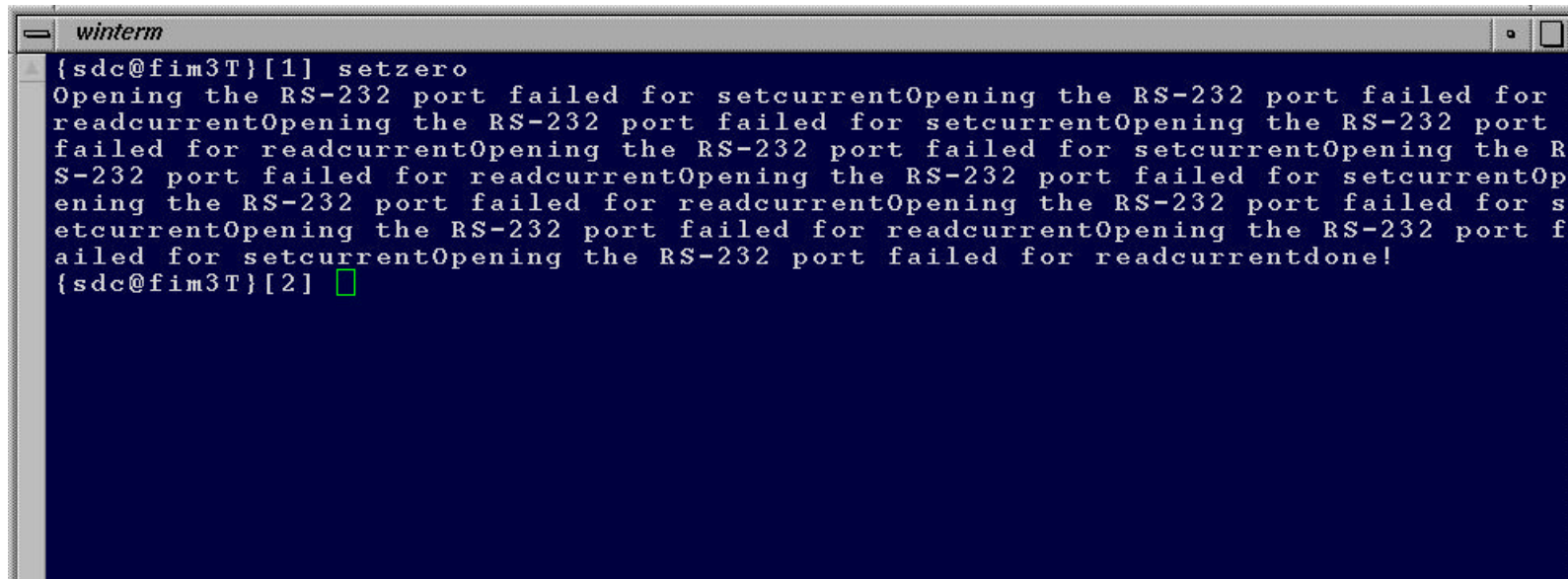
Set Zero in C Shell



```
winterm
{sdc@fim3T}[1] setzero
z2 at [      0.00]
z3 at [      0.00]
zx at [      0.00]
zy at [      0.00]
c2 at [      0.00]
s2 at [      0.00]
done!
{sdc@fim3T}[2] █
```

- Tools Icon
 - Type **setzero**
 - Enter

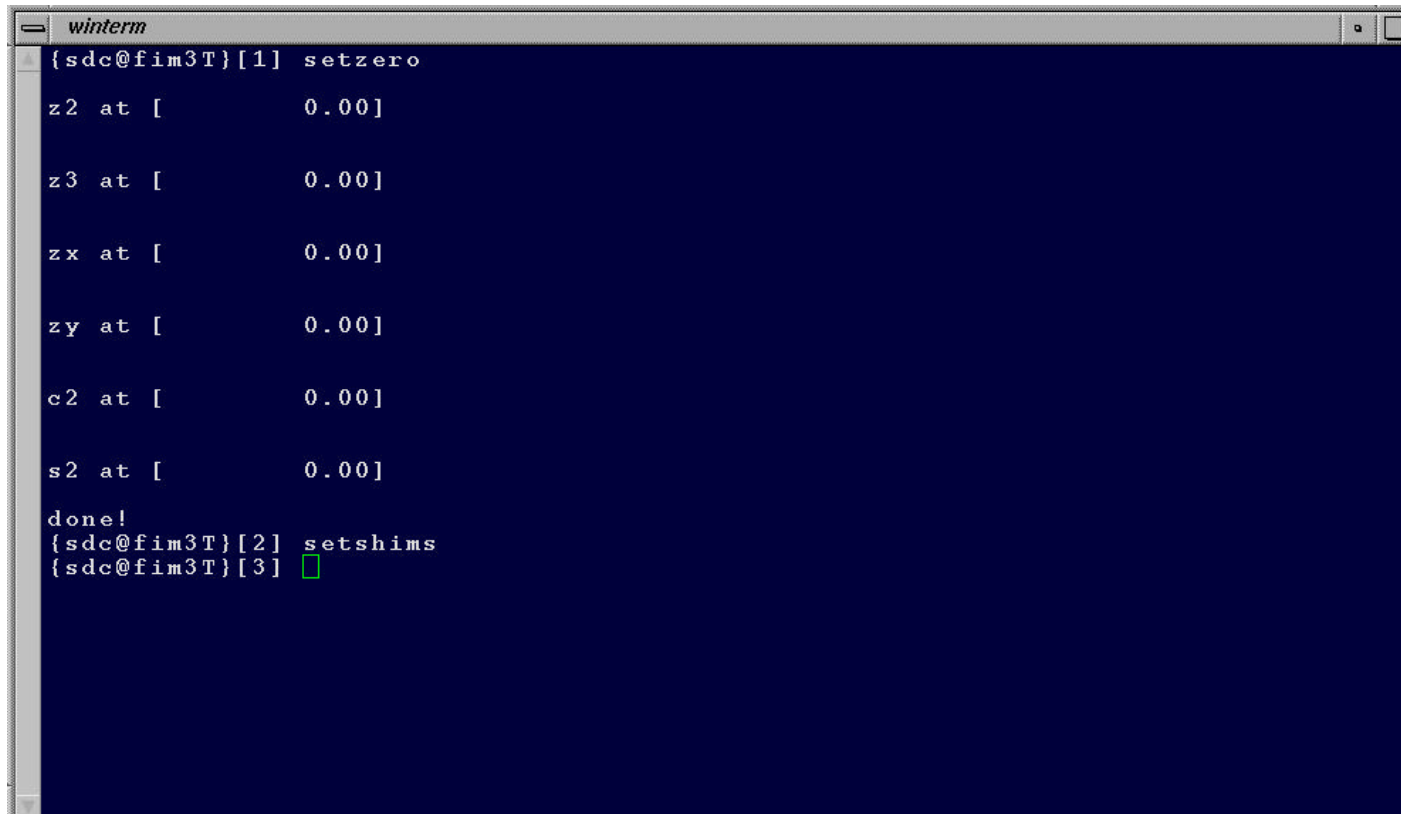
Failed Connection for Shims



```
winterm
{sdc@fim3T}[1] setzero
Opening the RS-232 port failed for setcurrentOpening the RS-232 port failed for
readcurrentOpening the RS-232 port failed for setcurrentOpening the RS-232 port
failed for readcurrentOpening the RS-232 port failed for setcurrentOpening the R
S-232 port failed for readcurrentOpening the RS-232 port failed for setcurrentOp
ening the RS-232 port failed for readcurrentOpening the RS-232 port failed for s
etcurrentOpening the RS-232 port failed for readcurrentOpening the RS-232 port f
ailed for setcurrentOpening the RS-232 port failed for readcurrentdone!
{sdc@fim3T}[2] █
```

- Tools Icon
 - Open a C Shell
 - Type setzero
- Failed Connection
 - Bring scanner down and then reboot until you get a good connection

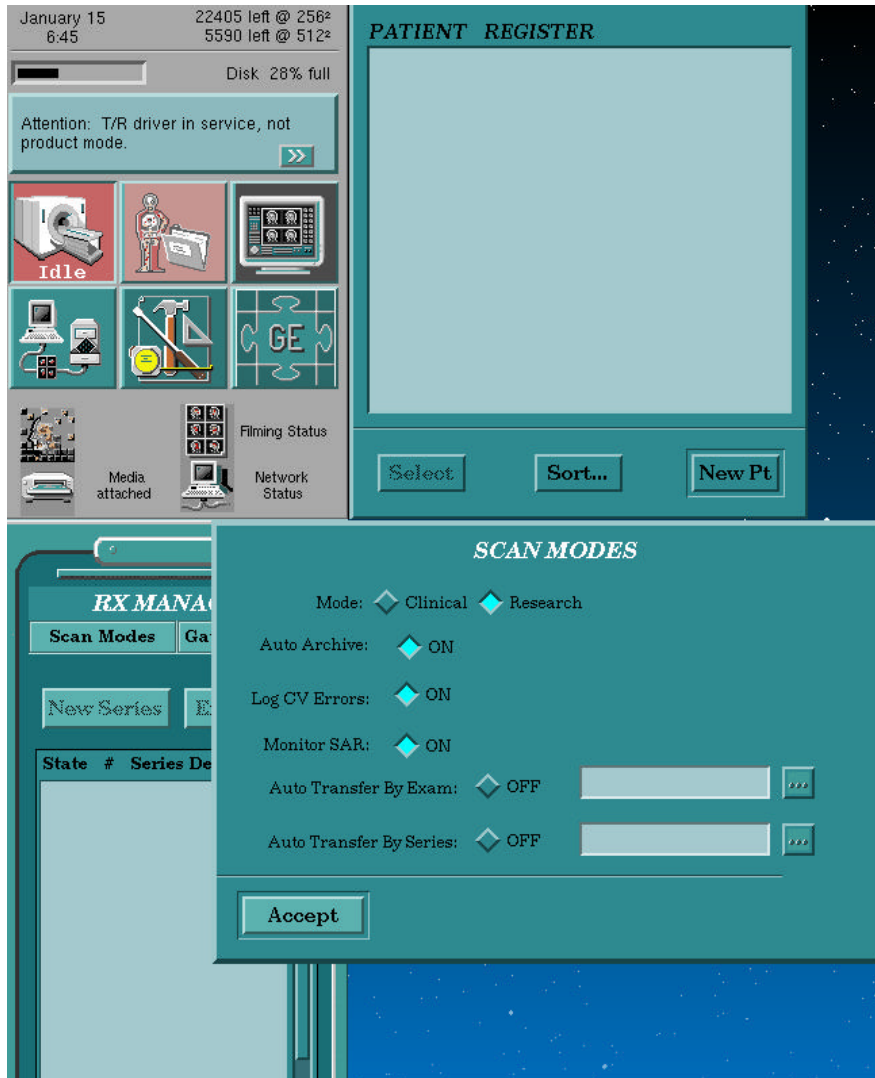
Set Shims in C Shell



```
winterm
{sdc@fim3T}[1] setzero
z2 at [ 0.00]
z3 at [ 0.00]
zx at [ 0.00]
zy at [ 0.00]
c2 at [ 0.00]
s2 at [ 0.00]
done!
{sdc@fim3T}[2] setshims
{sdc@fim3T}[3] 
```

- At prompt, type **setshims**
 - Only if preceded by a successful setzero command

The Scan Modes Window



- Click on Scan Modes
- Click on Research
 - Click **Confirm** at prompt
- Click on Auto Archive (for OD)
- Click on Log CV Error
- Click on Monitor SAR
(**Always!**)

Selection of Scan Modes During Morning Start-Up



- Research mode must be selected
- Auto Archive relates to the MOD
- Log CV errors for review
- Always monitor SAR

The Scan Modes Window_

Research Prompt



- Must Use Research Scan Mode except for the standard Clinical Scans (non-MP_Rage)

The Tools Icon Window



- TPS Reset
 - Click on TPS Reset
 - TPS Reset
 - Yes or No?
- System Shutdown
 - Click on System Shutdown
 - System Shutdown
 - Yes or No?
- C Shell
 - Set Zero
 - Set Shims
 - ShimCalc

TPS Reset



- Have scan locations written down
- Have Shim parameters written down
- TPS Reset
 - Click on TPS Reset
 - TPS Reset
 - Yes or No?
- Type MR at Patient ID
- Go Directly to Protocol #
- Scan
 - Do not have to re-landmark
 - Do not have to re-localize (EPI)

Pre Scan Options

- Auto Pre Scan
- Manual Pre Scan
- Auto Shim
- Manual Shim
- High Order Shim

Center Frequency

- *Center Frequency:*
 - The CF controls the position of the RF transmitter. This can be complicated by the fact that protons occur in two different chemical properties, water and fat. The protons in water and fat have two different resonance frequencies. Water resonates at about - 220 Hz higher than fat, at 1.5 Tesla / - 440 Hz at 3 Tesla.
 - $MCV > \text{off_rfcssat} = - 440$
 - $\text{opsat} = 1$
 - $\text{fatsat} = 1$

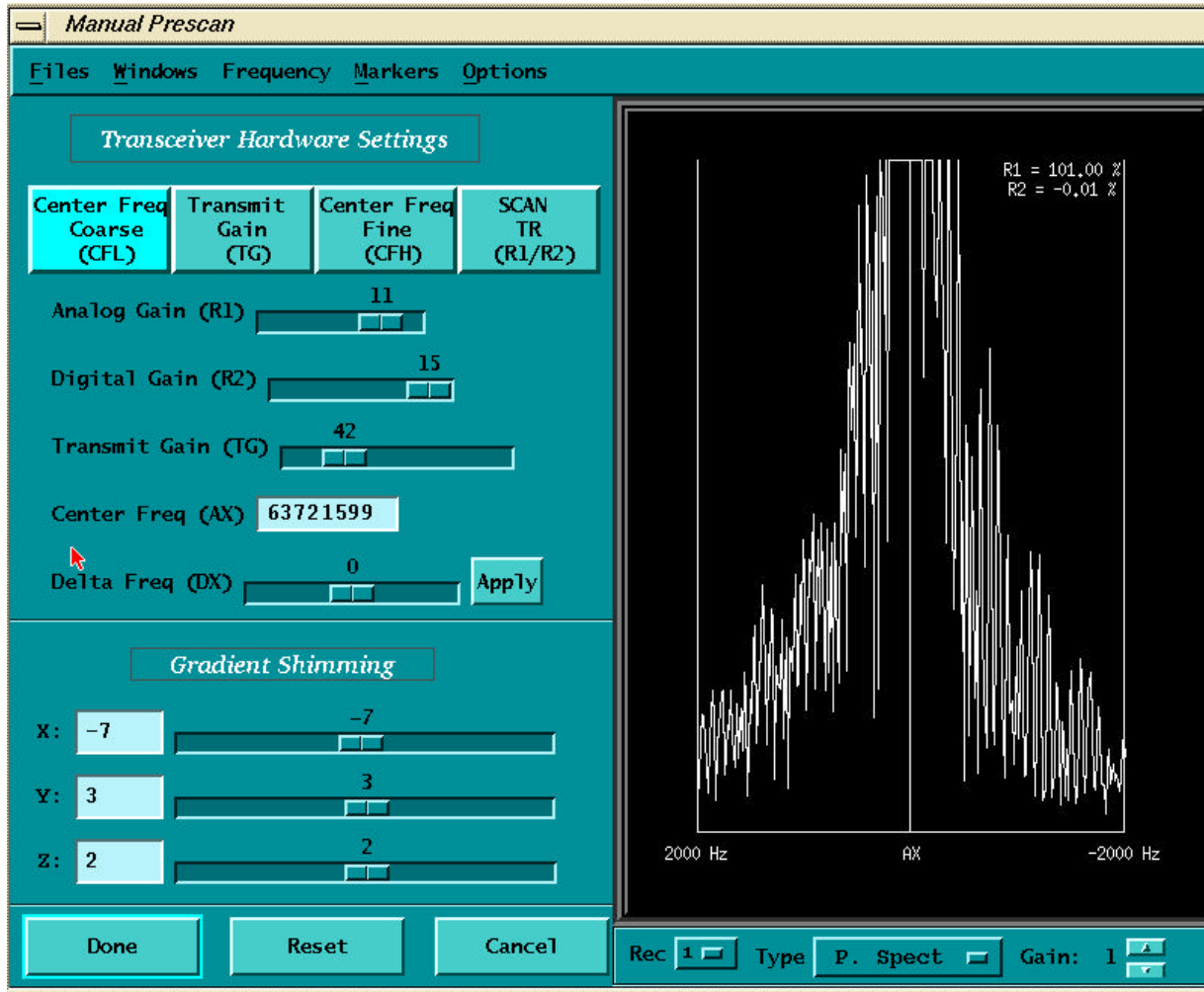
Prescan

- The Prescan allows for the adjustment of the transmit and receive gains and for the setting of the center frequency for a specific body part to be imaged.
- *Receive Gain:*
 - The RG is measured in tenths of decibels (dB). Receiver set to optimal dynamic range If this is set too high, it will result in over-range with artifacts. If it is set too low, signal to noise might suffer.

Transmit Gain

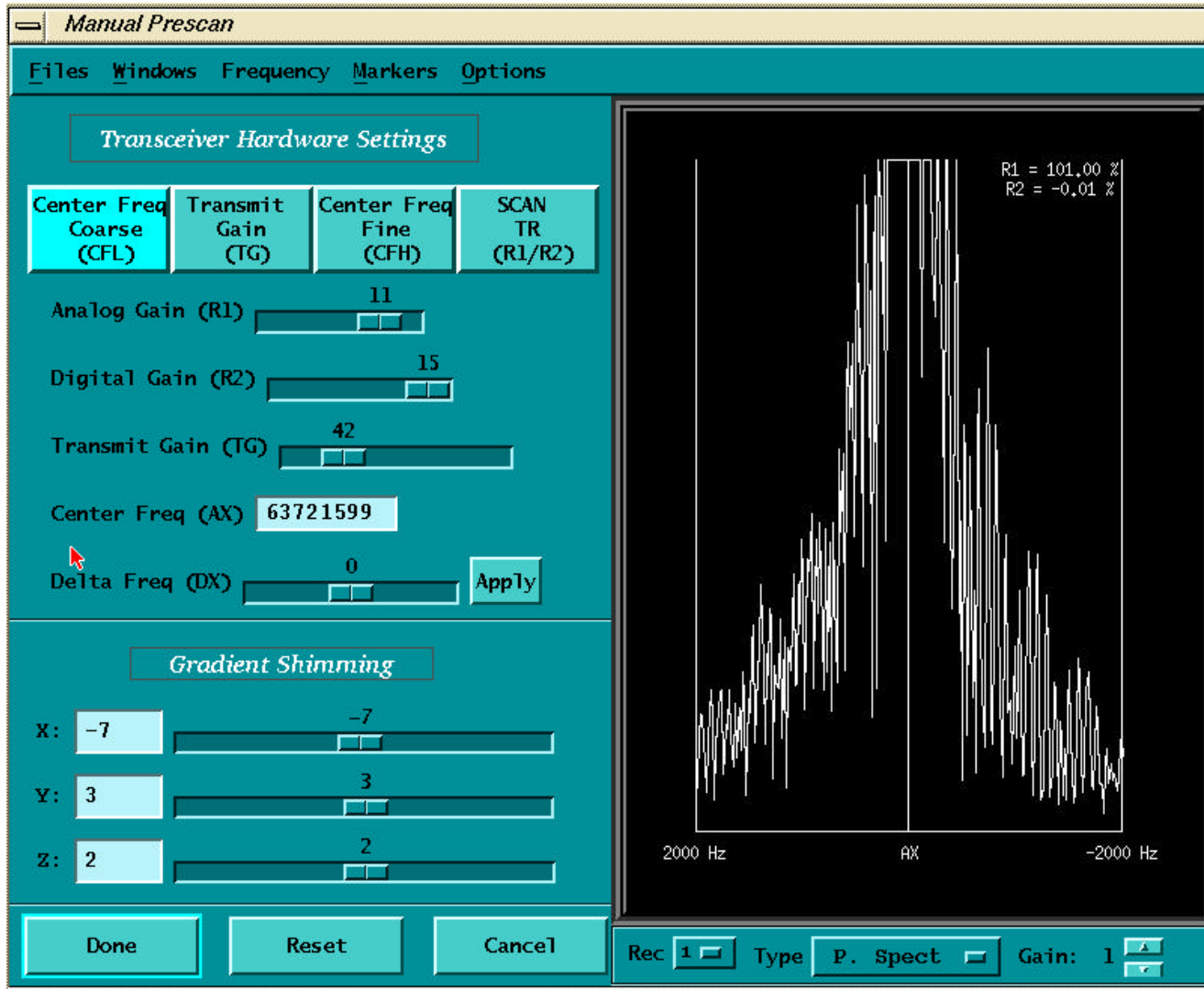
- The TG determines the RF power emitted by the transmitter and thus the pulse flip angle. The TG is expressed in tenths of decibels (dB).
- Power absorption is patient size dependent. The flip angle is proportional to the square root of the transmit power.

Pre Scan



- Center Frequency
- R1
- R2
- Transmit Gain (TG)
- Shim Values

Pre-Scan Over-Range

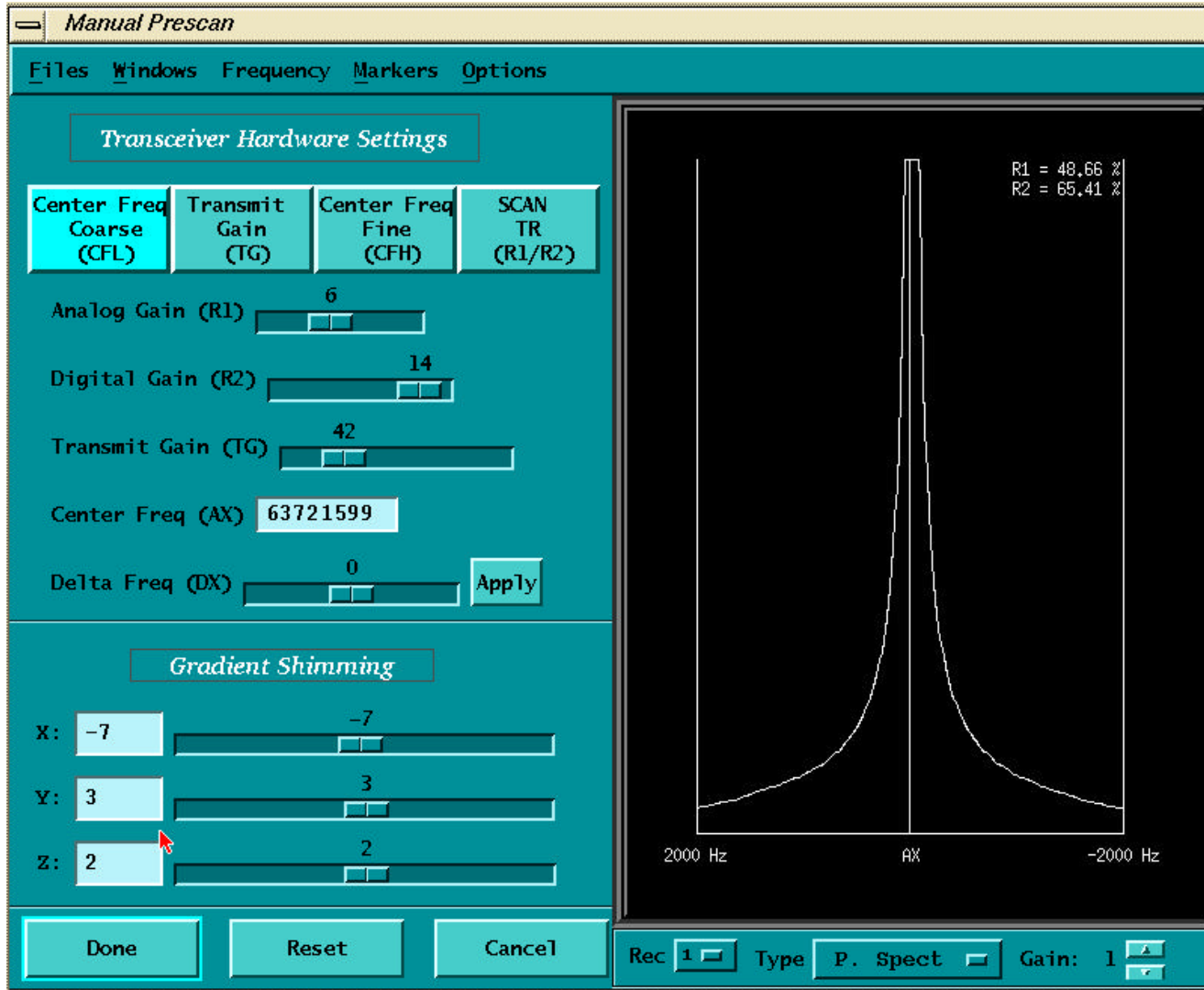


- $R1 > 100\%$

- $R2 > 100\%$

* resultant image
could demonstrate
artifacts and
distortions *

Proper Prescan Values



- Proper values are dependent on:
 - Magnet strength
 - Patient size
 - Pulse Sequence

Pre Scan Values on Operations Page

The screenshot displays the MRI Operations Page interface. It features several input fields for scan parameters, a 'SCANNING RANGE' section, and a status bar at the bottom. A red arrow points to the 'Prescan values' text in the status bar.

Parameters:

- TI2: 0
- Flip Angle: 0
- Echo Train Length: 0
- Bandwidth: 0.0
- BandwidthC: 0.0
- FOV: 24
- Slice Thickness: 5.0
- Spacing: 0.0

SCANNING RANGE:

	Min.	Max.	A / P	S/I Center	R/L Center
Start	0	0	0.0	0.0	0.0
End			0.0		
# Slices			1	Table Delta	0.00
Actual End			A0.0		

Status Bar:

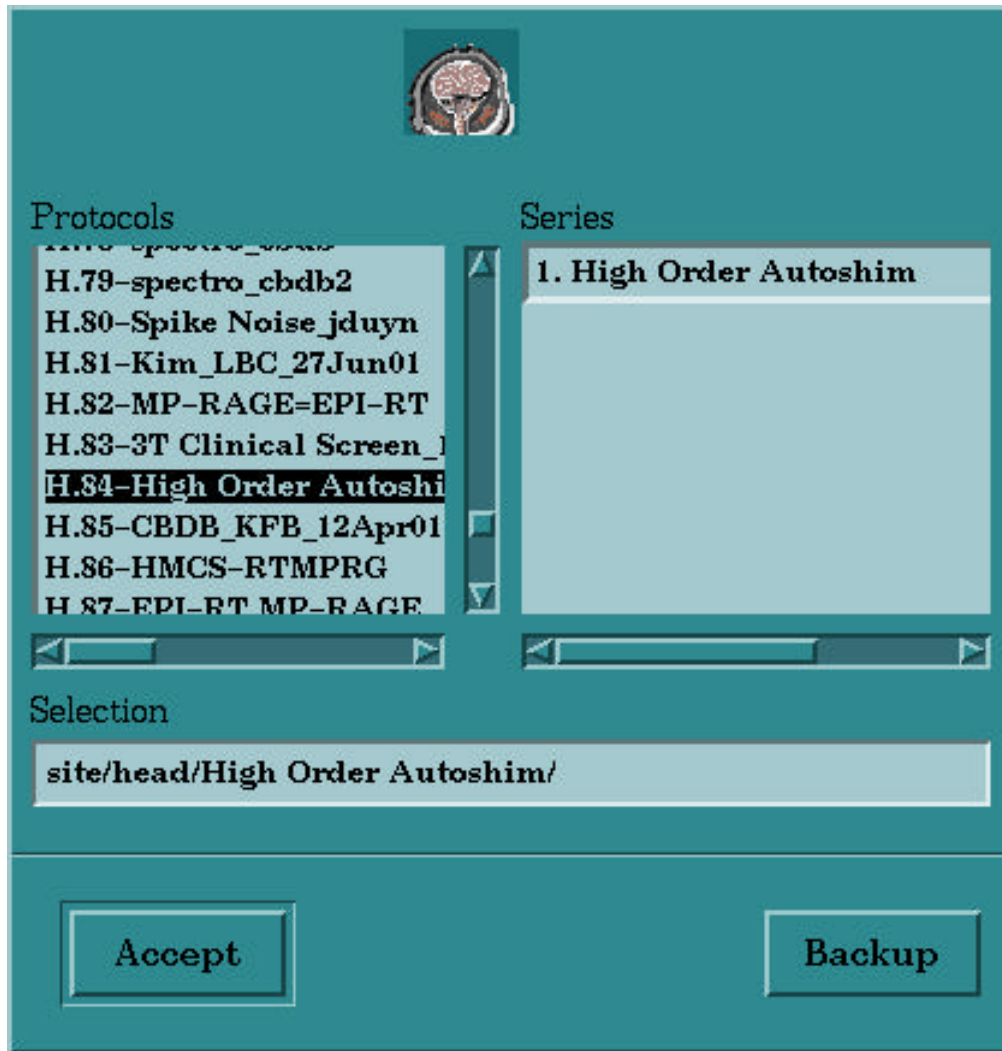
- Rx Scan Time: 00:00
- Rel. SNR(%): 100
- Max # of Slices /Acq: 0
- Save Series
- iDrive FPS: <1
- Est. SAR: 0.0000
- Average Head SAR: 0.0000
- Peak SAR: 0.0000
- # of Acqs: 0
- Reset Values
- Prescan values R1: 6 R2: 14 TG: 42 AX: 63721621
- Research Operations ...
- Scan Time: 2:00
- dB/dt: 66%
- Auto Prescan
- Manual Prescan
- Prep Scan
- Scan

- It's a good idea to write down the Prescan values for multiple series...especially EPI

Shimming...Why??

- To obtain good homogeneity of the field
- Fine tuning of the coil to the magnet to the body part at isocenter

High Order AutoShim_Step One



- Click on a Pre-made Protocol that contains the High Order Shim Parameters

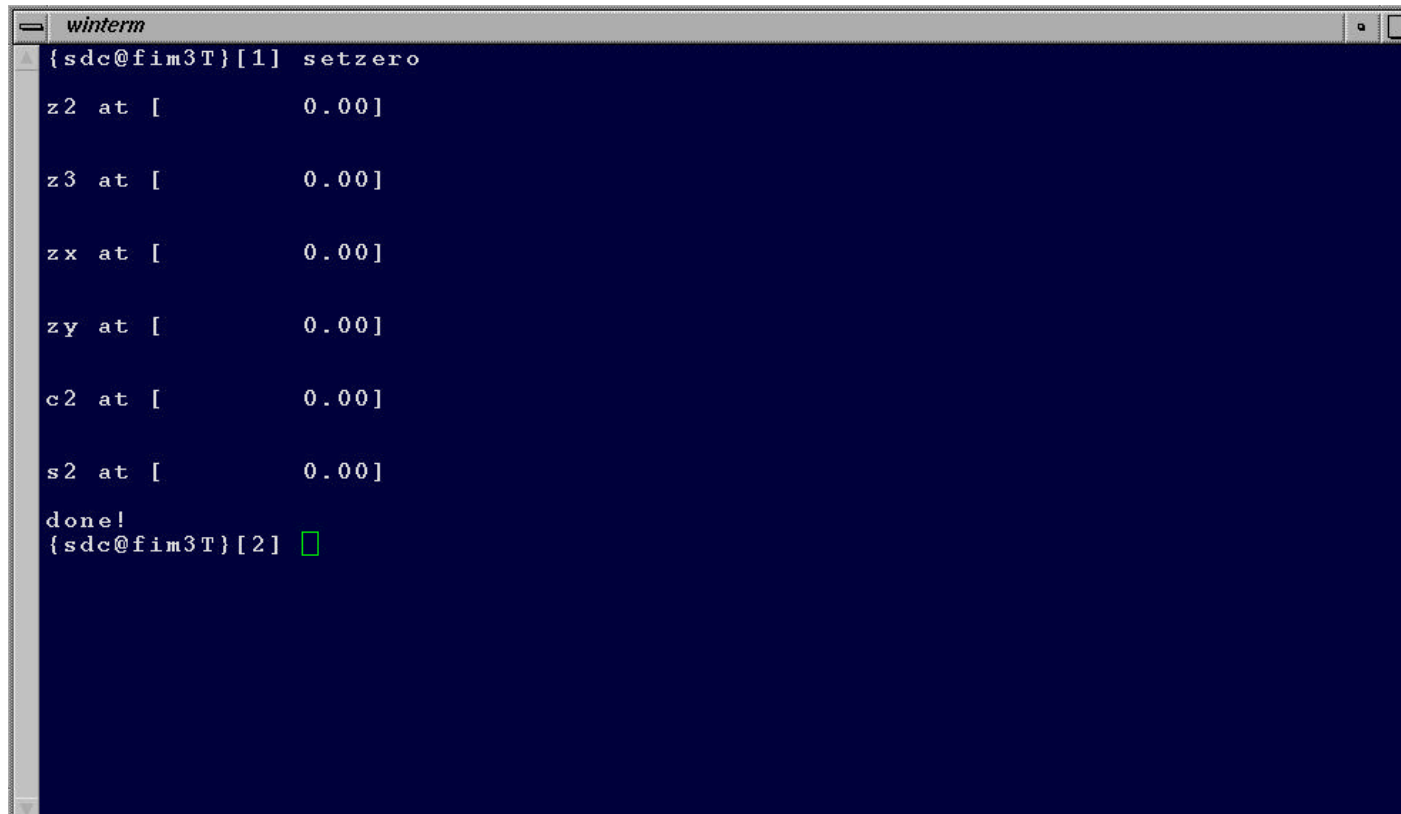
Parameters for the High Order AutoShim

SCAN TIMING			ADDITIONAL PARAMETERS				ACQUISITION TIMING							
# of Echoes			Min.	Max.										
# of Echoes	1	2	0.0	0.0					Freq	64	>	Freq DIR	A/P	>
TE	7.0	< >	0.0	0.0	SAT	Graphic Rx	Vascular Screen	User CVs Screen	Phase		>	Auto Center Freq	Water	>
TR	1500	< >	0	0	Gating/Triggering	Cine Screen	Mult Phase Screen	DWI Screen	NEX	1.00	>	Flow Comp Direction		>
T1		< >	0	0					Phase FOV		>	Autoshim	Phase Correct	
T12		< >	0	0							Contrast	Anmit		
Flip Angle	60	< >	0	0					# of Lines Before Pause		>	Agend		
Echo Train Length		< >							SCANNING RANGE					
Bandwidth		< >	0.0	0.0	FOV	32	< >	Min.	0	Max.	0	S/I	L/R.Center	P/A.Center
Bandwidth		< >	0.0	0.0	Slice Thickness	7.5	< >	Start	\$116.2		0.0	End	I116.2	
					Spacing	0.0	< >	# Slices	32		Table Delta	0.00		
									Actual End	I116.3				

Rx Scan Time:	00:00	Rel. SNR(%):	100	>	Max # of Slices /Acq.:	0
iDrive FPS:<1	Est. SAR:0.0000	Average Head SAR: 0.0000	Peak SAR:0.0000	# of Acqs.:	0	Reset Values

- Change only the Start and End Locations
 - To match the EPI scan locations
- Save, Download and click Scan
 - (no need to Auto Pre-scan)

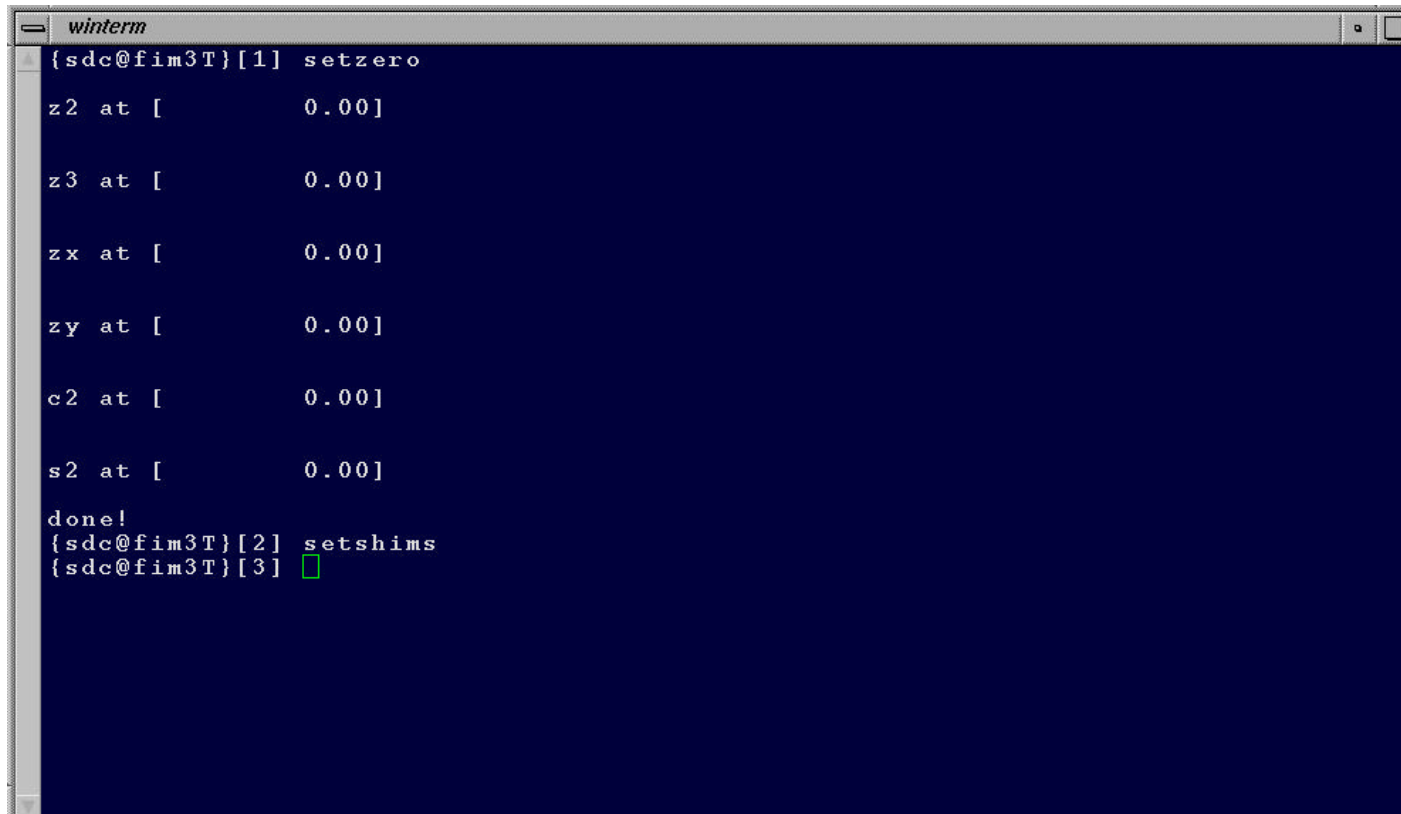
Set Zero in C Shell



```
winterm
{sdc@fim3T}[1] setzero
z2 at [      0.00]
z3 at [      0.00]
zx at [      0.00]
zy at [      0.00]
c2 at [      0.00]
s2 at [      0.00]
done!
{sdc@fim3T}[2] █
```

- Tools Icon
 - Type **setzero**
 - Enter

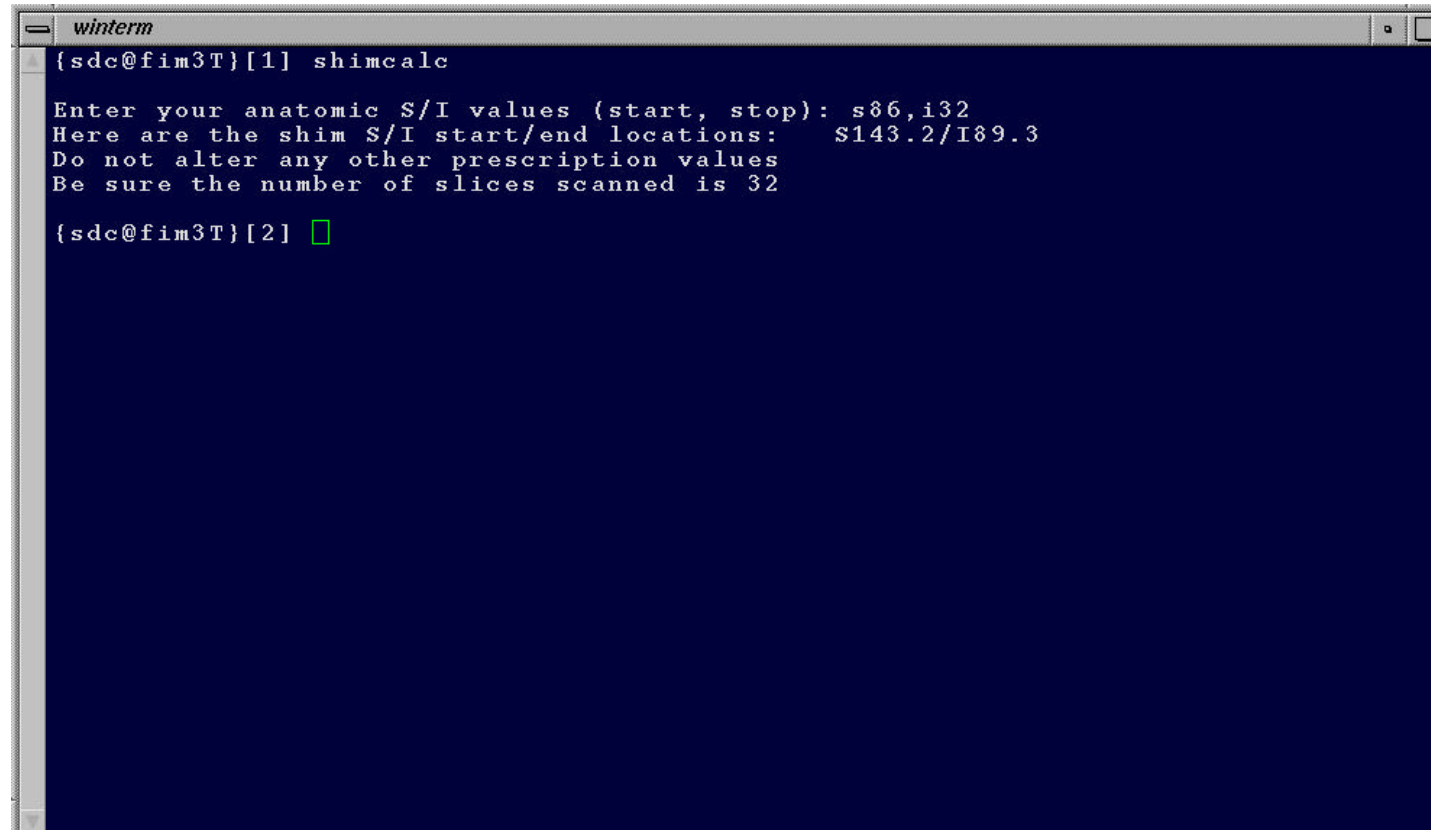
Set Shims in C Shell



```
winterm
{sdc@fim3T}[1] setzero
z2 at [ 0.00]
z3 at [ 0.00]
zx at [ 0.00]
zy at [ 0.00]
c2 at [ 0.00]
s2 at [ 0.00]
done!
{sdc@fim3T}[2] setshims
{sdc@fim3T}[3] 
```

- At prompt, type **setshims**
 - Only if preceded by a successful setzero command

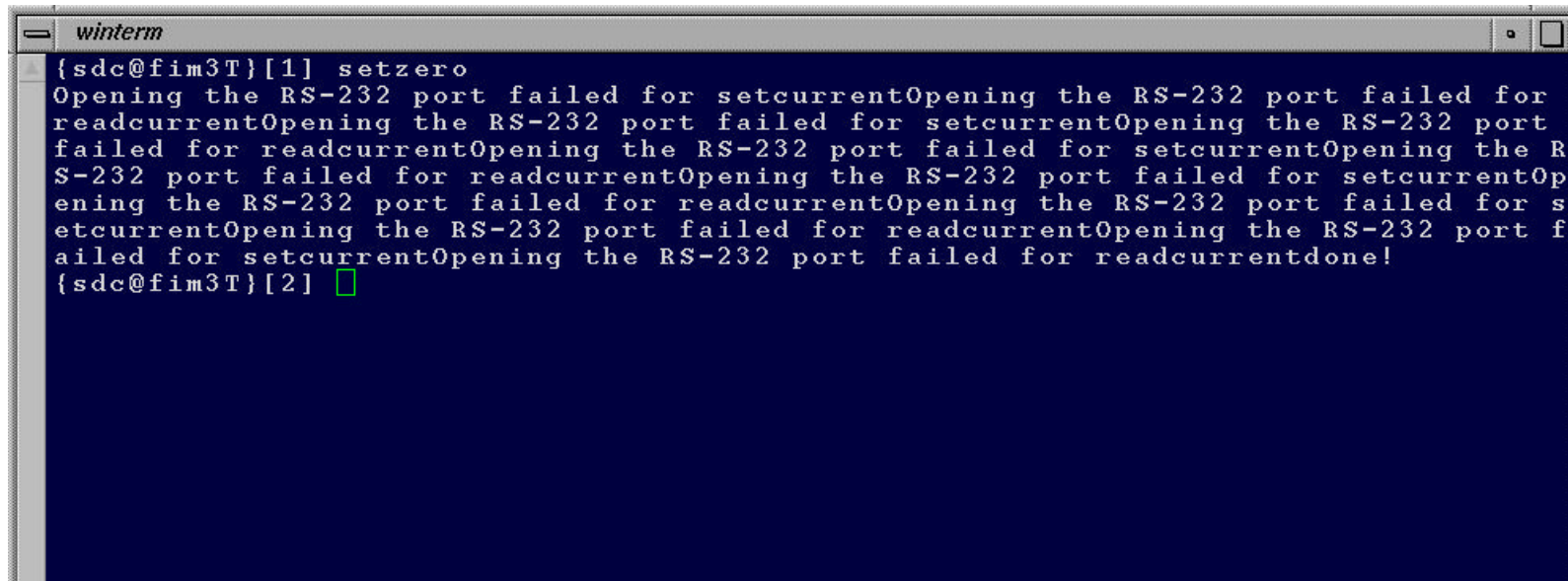
The ShimCalc Option



```
winterm
{sdc@fim3T}[1] shimcalc
Enter your anatomic S/I values (start, stop): s86,i32
Here are the shim S/I start/end locations: S143.2/I89.3
Do not alter any other prescription values
Be sure the number of slices scanned is 32
{sdc@fim3T}[2] █
```

- Tools Icon
 - Open a C Shell in the Tools
 - Type shimcalc

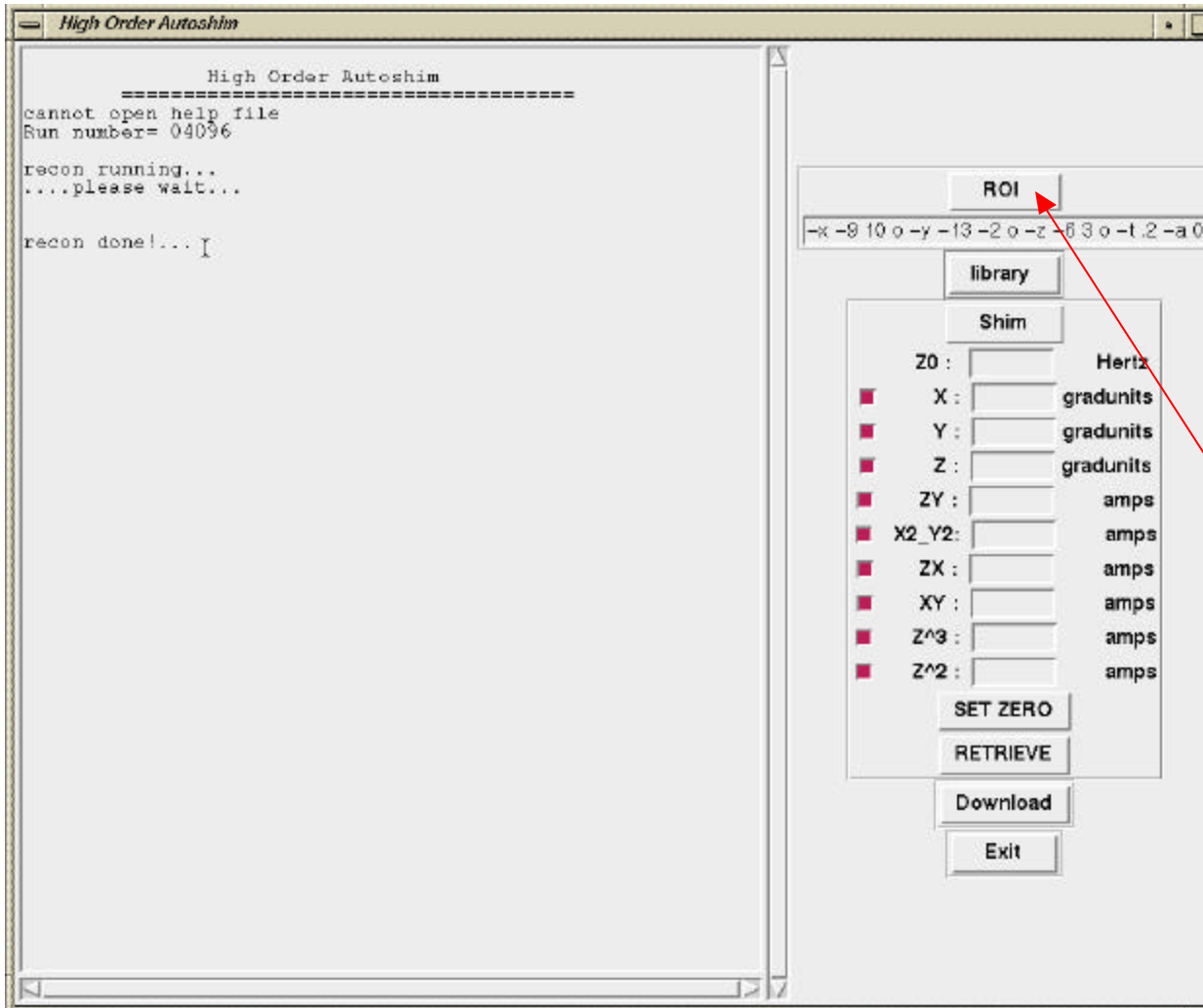
Remember! Failed Connection for Shims



```
winterm
{sdc@fim3T}[1] setzero
Opening the RS-232 port failed for setcurrentOpening the RS-232 port failed for
readcurrentOpening the RS-232 port failed for setcurrentOpening the RS-232 port
failed for readcurrentOpening the RS-232 port failed for setcurrentOpening the R
S-232 port failed for readcurrentOpening the RS-232 port failed for setcurrentOp
ening the RS-232 port failed for readcurrentOpening the RS-232 port failed for s
etcurrentOpening the RS-232 port failed for readcurrentOpening the RS-232 port f
ailed for setcurrentOpening the RS-232 port failed for readcurrentdone!
{sdc@fim3T}[2] █
```

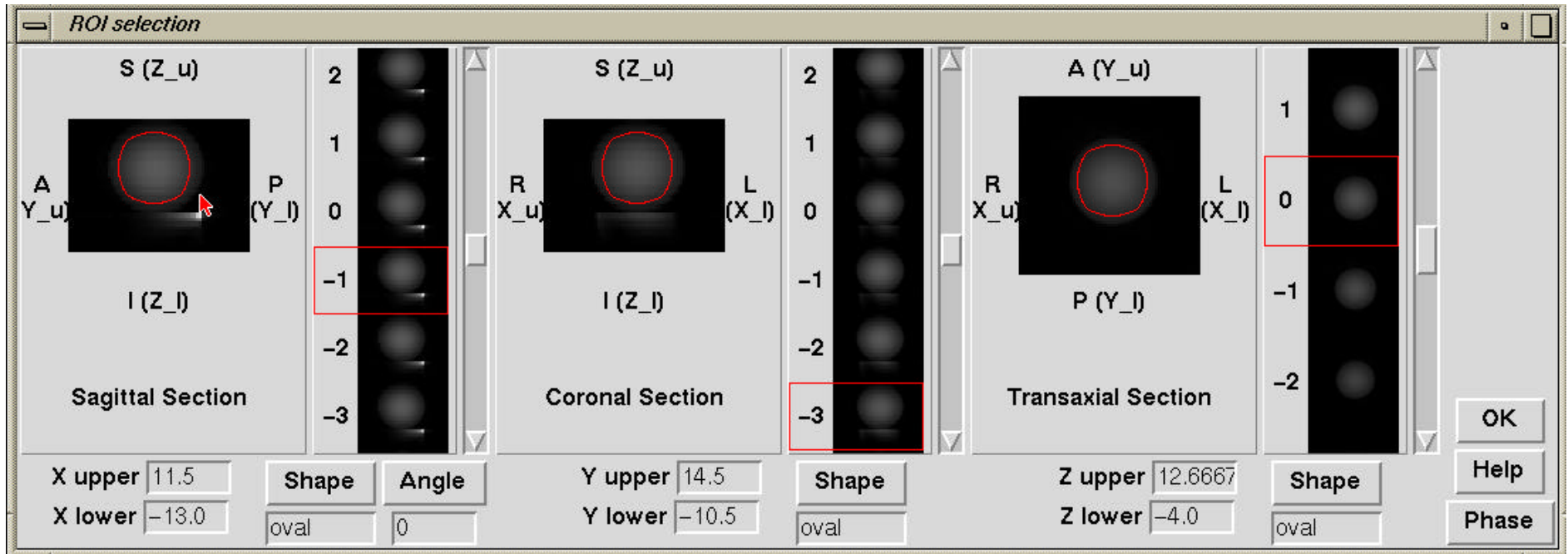
- Tools Icon
 - Open a C Shell
 - Type setzero
- Failed Connection
 - Bring scanner down and then reboot until you get a good connection

High Order AutoShim



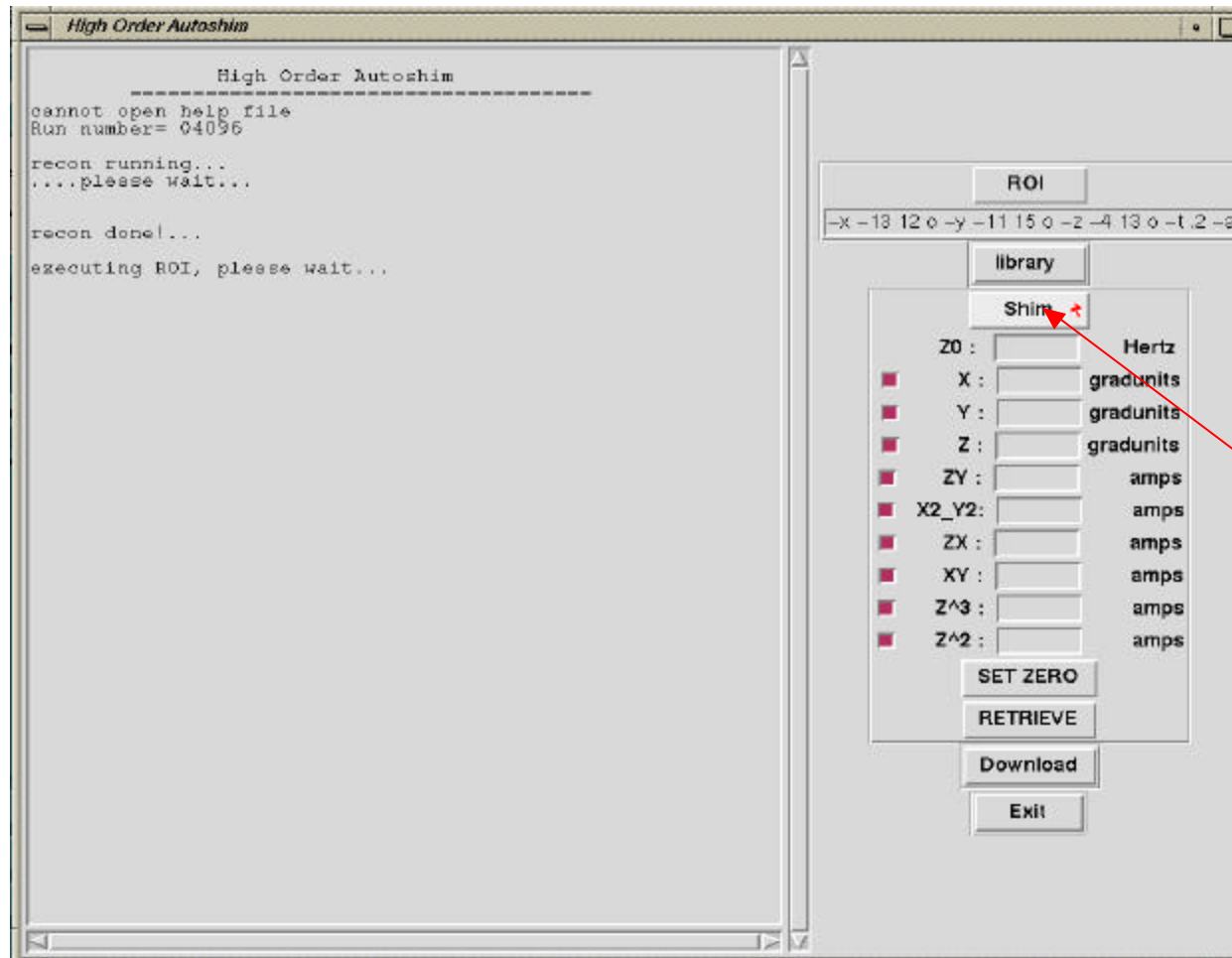
- Wait for the “Recon Done” message
- Click on ROI

High Order AutoShim - ROI Placement



- Be sure to place the ROI correctly
 - Not too small
 - Not too large
 - All 3 planes

High Order AutoShim



- Wait for ROI values
- Click on SHIM

Results from the High Order AutoShim

The screenshot shows the 'High Order AutoShim' window. The left pane displays text-based results, and the right pane contains a graphical control interface.

Shim

=====

Field Map Information

File data/P999999.7
Size 64 64 32
Phasedelay 2.00

Reference File Information

File /w/config/ho_shim/reference/reference.pa
Size 64 64 32
Phasedelay 2.00
Number of shims ... 10

Shim Volume Information

Shim region: elliptical
Shim performed over x=-12.13, y=-15.11, z=-13.4
Oblique angle shimmed over: 0.00
Number of points in VOI 3935
Number of shims used for solution 10

Current Field Map Statistics

RMS deviation 3.30 Hz
Peak deviation ... 18.00 Hz

Predicted Field Map Statistics

RMS deviation 3.28 Hz
Peak deviation ... 18.84 Hz

Delta currents required

z0	...	-1.041 Hertz
x	...	-0.007 gradunits
y	...	-0.008 gradunits
z	...	-0.023 gradunits
zy	...	0.000 amps
x2y2	...	0.000 amps
zx	...	0.000 amps
xy	...	0.000 amps
z3	...	0.000 amps
z2	...	-0.001 amps

Shim done!...

ROI

-x -13.12 o -y -11.15 o -z -4.13 o -t 2 -a

library

Shim

Z0 : 1 Hertz

X : 0 gradunits

Y : 0 gradunits

Z : 0 gradunits

ZY : 0.0 amps

X2_Y2 : 0.0 amps

ZX : 0.0 amps

XY : 0.0 amps

Z^3 : 0.0 amps

Z^2 : 0.001 amps

SET ZERO

RETRIEVE

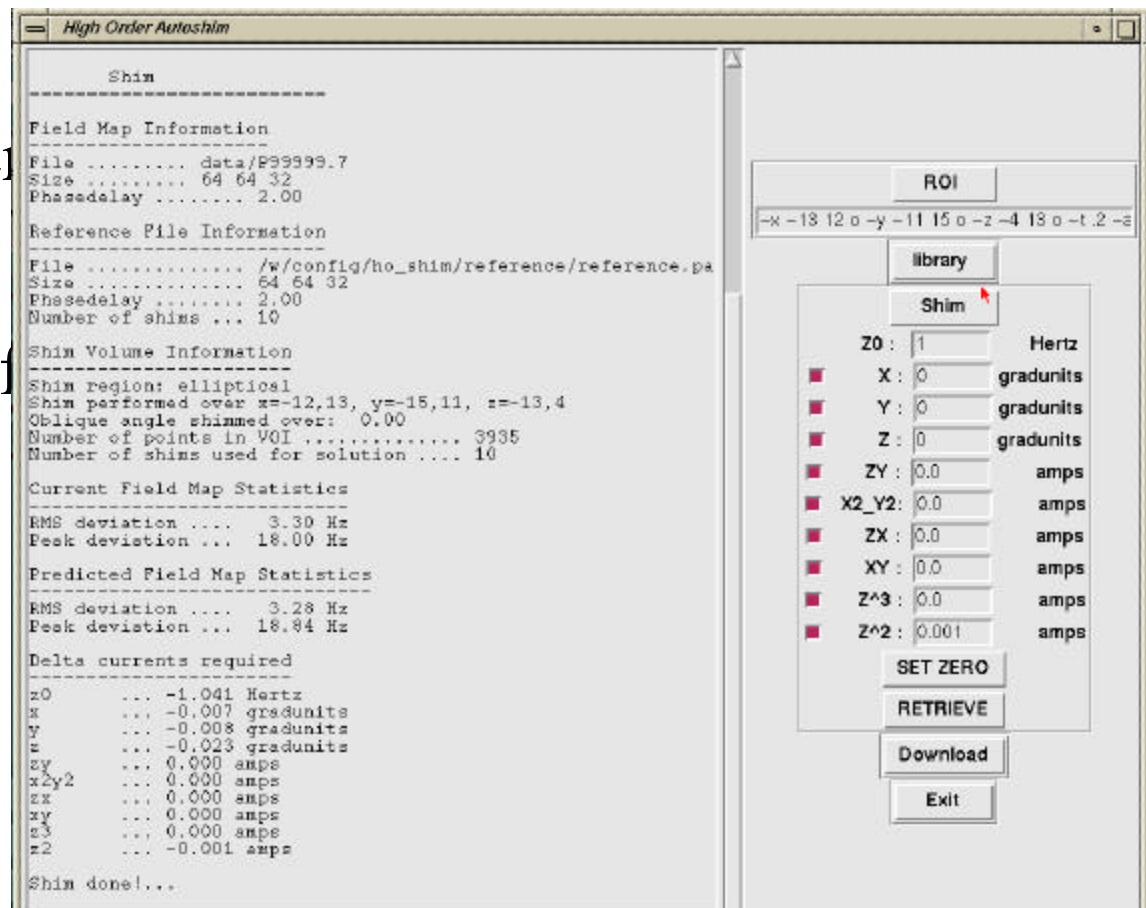
Download

Exit

- Wait for SHIM results
 - “SHIM DONE!”
- Acceptable Z_0 Shim value
 - = +/- 3 Hz
 - Download
- Exit

High Order Auto Shim ?

- X, y, z = gradient shims of the 1st order
- x^2, y^2, z^2 = values of the gradient shims times itself
- X^3, y^3, z^3 = values cubed



User CV Window

USER CONTROL VARIABLES

			Minimum	Maximum
CV 2	fat suppression (ON=1,OFF=0)	<input type="text" value="0.00"/>	0	1
CV 3	crusher duration (long=1,short=0)	<input type="text" value="1.00"/>	0	1
CV 4	number of reps (even number)	<input type="text" value="60.00"/>	1	16384
CV 5	GE or SE (GE=2, SE=1)	<input type="text" value="2.00"/>	1	2

- CV = Control Variable
- The User CV Window is located within the Scanner Operations Pages
- Do not confuse with the Research Options Page
 - Display CV's

Auto View Window



- Exam number
 - Series number
 - Image number
- Click *Autoview* for image updates
- Click *Report Cursor* for location information

ECG Gating Control Window

GATING CONTROL

Waveform Display

☐ Cardiac

ECG Noise Filter: ☐ OFF

Advanced ECG Gating: ☒ ON

☐ Respiratory

☐ ECG Histogram

Cardiac Sweep Rate

☐ 10mm/sec

☐ 21mm/sec

☒ 41mm/sec

Gating Reset

Lead Display

☒ ECG-I

☒ ECG-II

☒ ECG-III

☒ PG

☒ Auto

Cardiac Trigger Level

☐ 50%

☐ 60%

☐ 70%

☒ Auto

Trigger Level: %

Update

R-peak Amp. mV

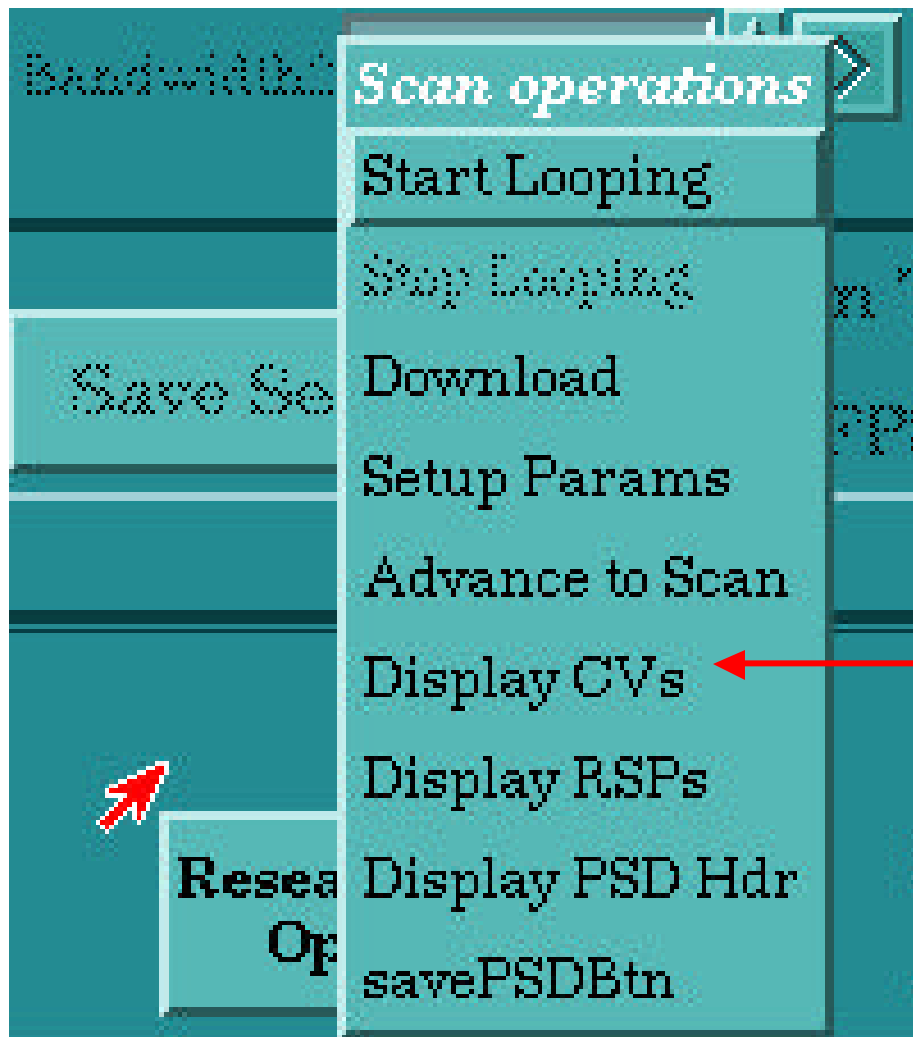
Cardiac Trigger Level Annotation: ☐ OFF

Audio Trigger Volume: 5

Accept

- This is the Default setting
 - Click on appropriate settings for gating or pulse oximetry

Research Options



**must be in Research
Scan Mode ** to
display the CV's

- Use RMB

– Display CV's

Display CV's in Research Options

Display CVs

CV Names

ASave_sar	CV Name :	prep
ASpeak_sar	Type :	Integer
ChemSatPulse	Current Value :	1
FTGacq1	Minimum :	0
FTGacq2	Maximum :	1
FTGau	Comment :	Prescan flag
FTGecholbw		
FTGfov		
FTGopslthickz1		
FTGopslthickz2		
FTGopslthickz3		
FTGtau1		
FTGtau2		
FTGtecho		
FTGtestpulse		
FTGwindow		
FTGxmtadd		
FTGxres		
GAM		

Accept

- Use RMB to open CV's
- Change the Current Value if necessary

Anatomical Image Scanning

- Anatomy
- Morphology
- Structural
- Clinical Scans

Clinical Scans

The Clinical Scans

- Required on all subjects 1 x per year
- Required if order reads “MRI Brain”

Clinical Screen H.83

PATIENT INFORMATION

Accession Number

Patient ID 00-00-00-0

Patient Name LastName, FirstName M

Birth Date 01/14/1967 Age 35

Sex M Weight 189 Lb

Rad Neuro Refer V

Operator xyz Status

Exam Description fMRI/TactileResponse/6'

History NV/GE Coil/01-M-0173

PATIENT PROTOCOLS

Protocols

- H.75-spectro_cdb02
- H.80-Spike Noise_jduyn
- H.81-Kim_LBC_27Jun01
- H.82-MP-RAGE=EPI-RT
- H.83-3T Clinical Screen**
- H.84-High Order Autoshi
- H.85-CBDB_KFB_12Apr01
- H.86-HMCS-RTMPRG
- H.87-EPI-RT.MP-RAGE
- H.88-QA_Daily_01Mar01

Series

- 1. 3-Plane Brain Localizer
- 2. Axial 3D FSGPR HIRES
- 3. PDW FSE TE 17/TR 3800
- 4. Sag 3D FSGPR HIRES
- 5. T2W FSE TE 107/TR 3800

Selection

site/head/3T Clinical Screen_15Mar01/

AUTOVIEW

Ext: 5666 QA_Daily Phantom

Set: 1

Im: 3

Cor: A0.0

LOC/30

TR:8

TE:1.8/Pr

EC:1/1 31.2kHz

FOV:24x24 W = 3042 L = 1521

☐ Autoview ☐ ReportCursor

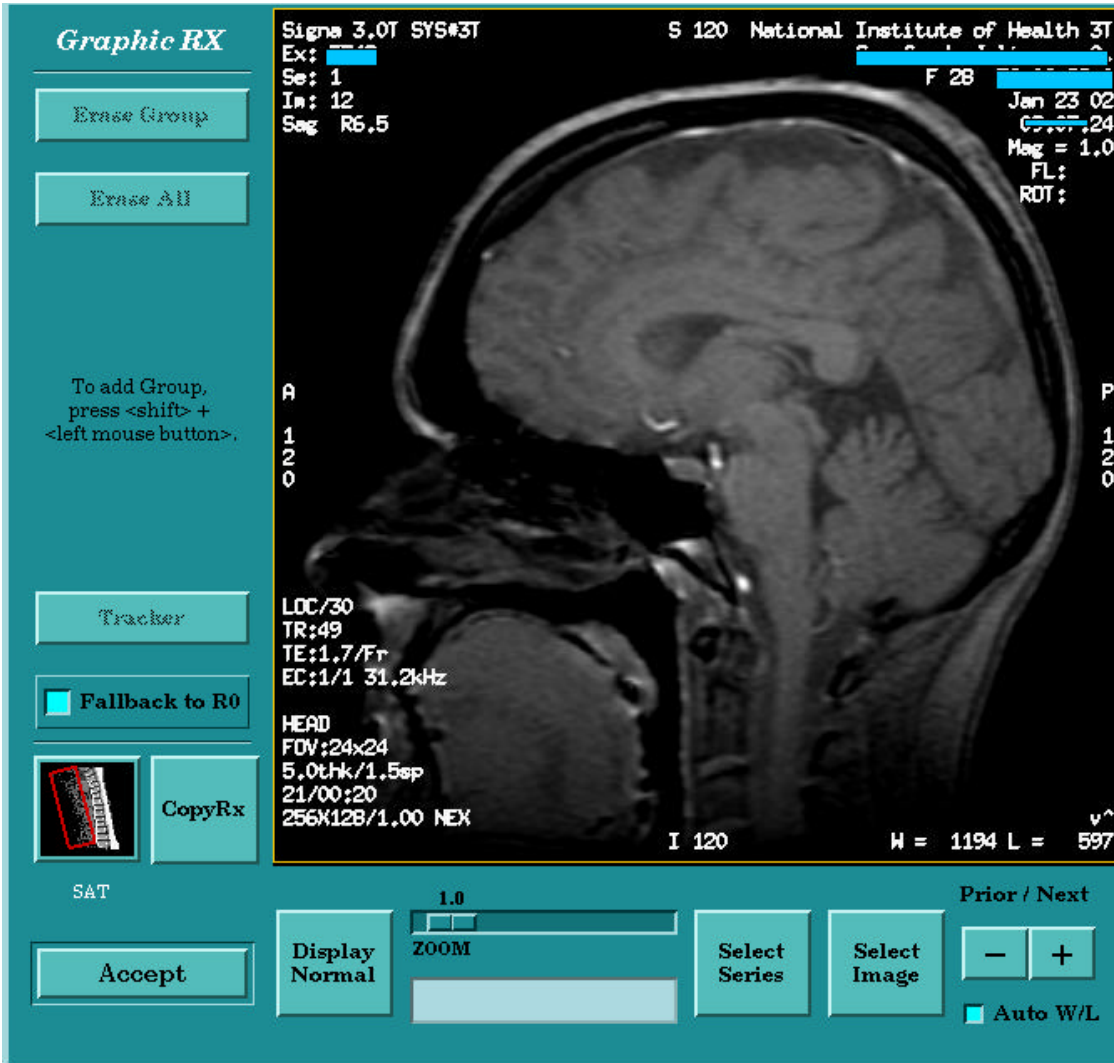
☐ Auto W/L ☐ Save W/L

- This is the correct Clinical Screen Protocol for 3T-1
- Clinical Screen Protocol is Scanner Dependent
 - Check with the technologist for correct protocol

Clinical Scans on 3T-1

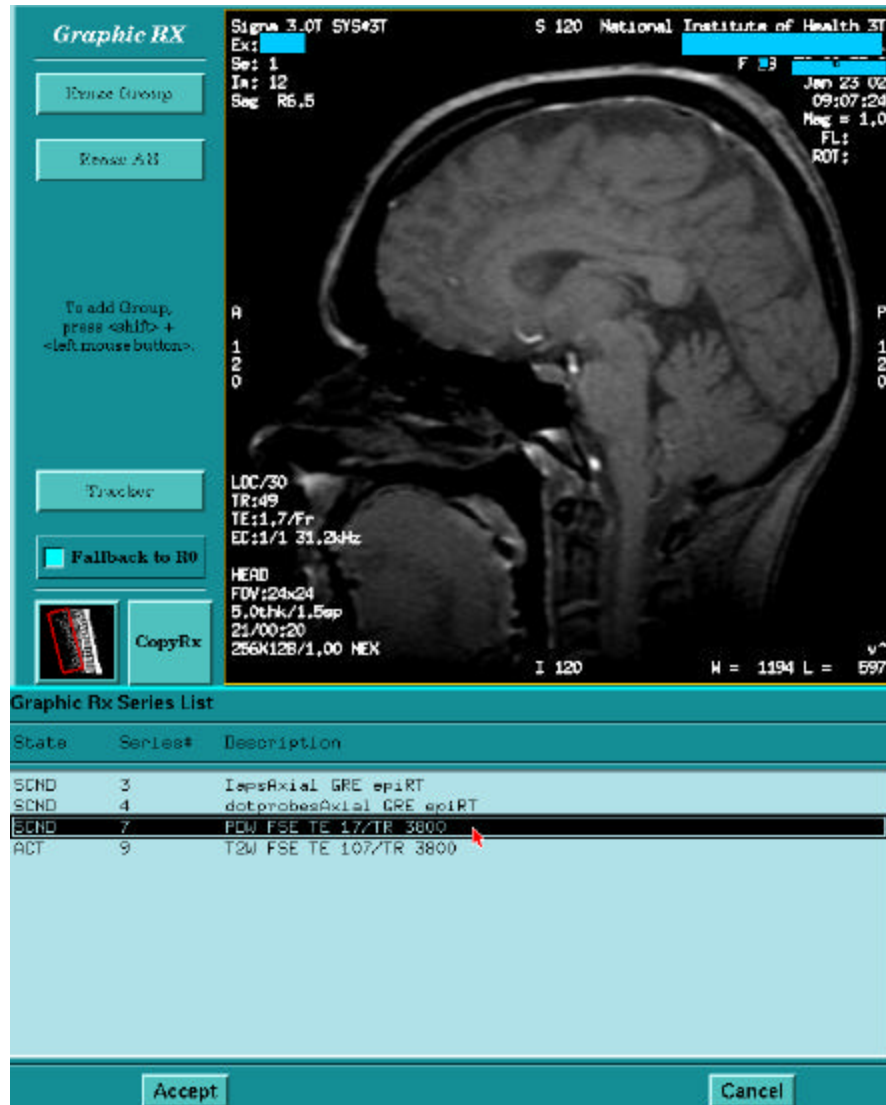
- Head. 83
- 1. 3 plane localizer
- 2. Axial T1 W, 3D, with IR Prep *
- (to replace the SE T1W)
- 3. Sag T1 W, 3 D, with IR Prep
- (to replace the SE T1W)
- 4. Axial PDW FSE, single echo
- (match slices exactly to the T2W)
- 5. Axial T2W FSE, single echo
- (match slices exactly to the PDW)
-
- All scans are head-first and Supine using the GEMS/MAI head coil
- * May use MP-RAGE for the Axial FSPGR
- The scan locations for the PDW FSE and the T2W FSE must match

Using the Copy RX Option



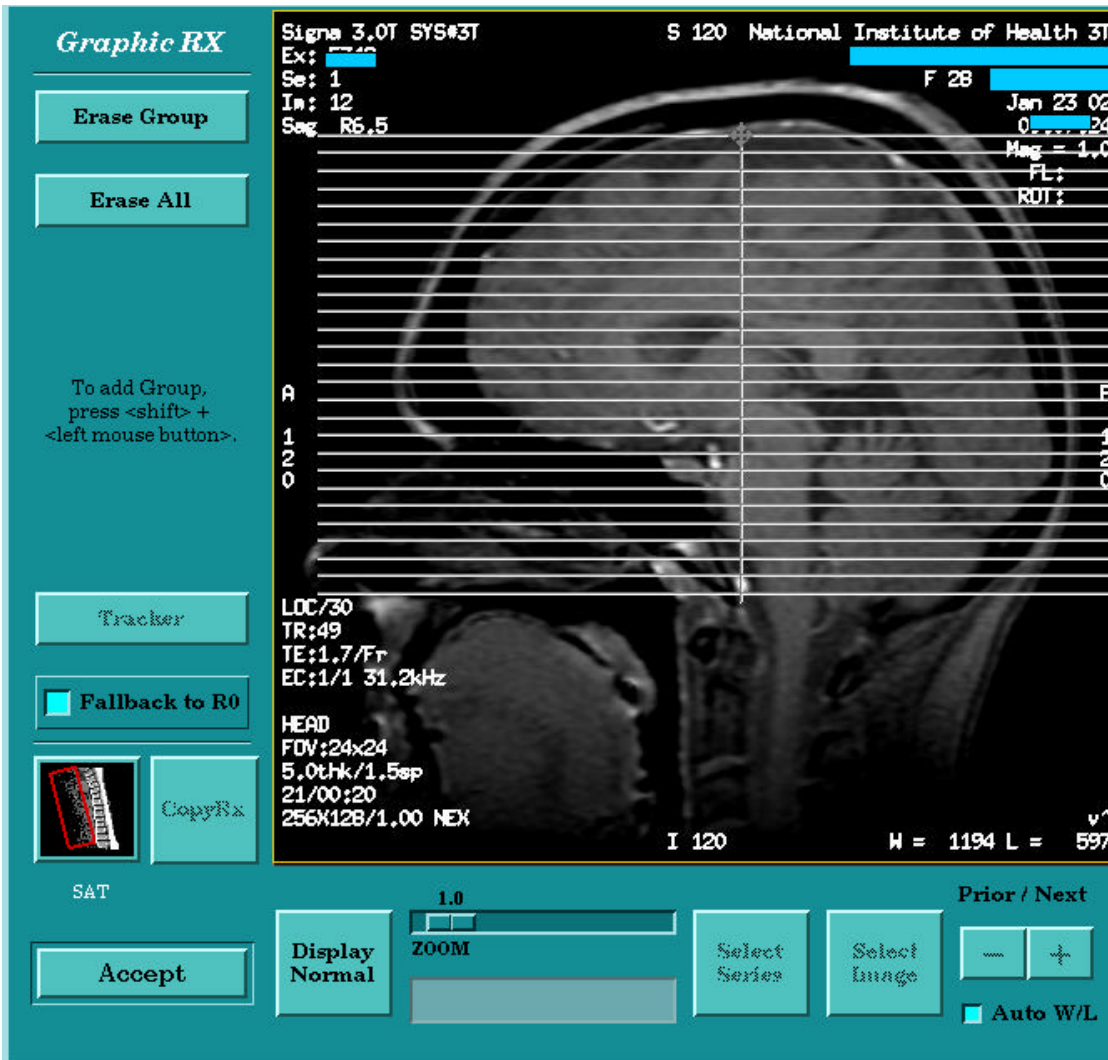
- *Copy RX_Step 1*
- *Bring up the correct image*
 - *Sagittal for Axial or Coronal Slices*
 - *Axial for Sagittal or Coronal Slices*
 - *Coronal for Axial for Sagittal Slices*

Using the Copy RX Option



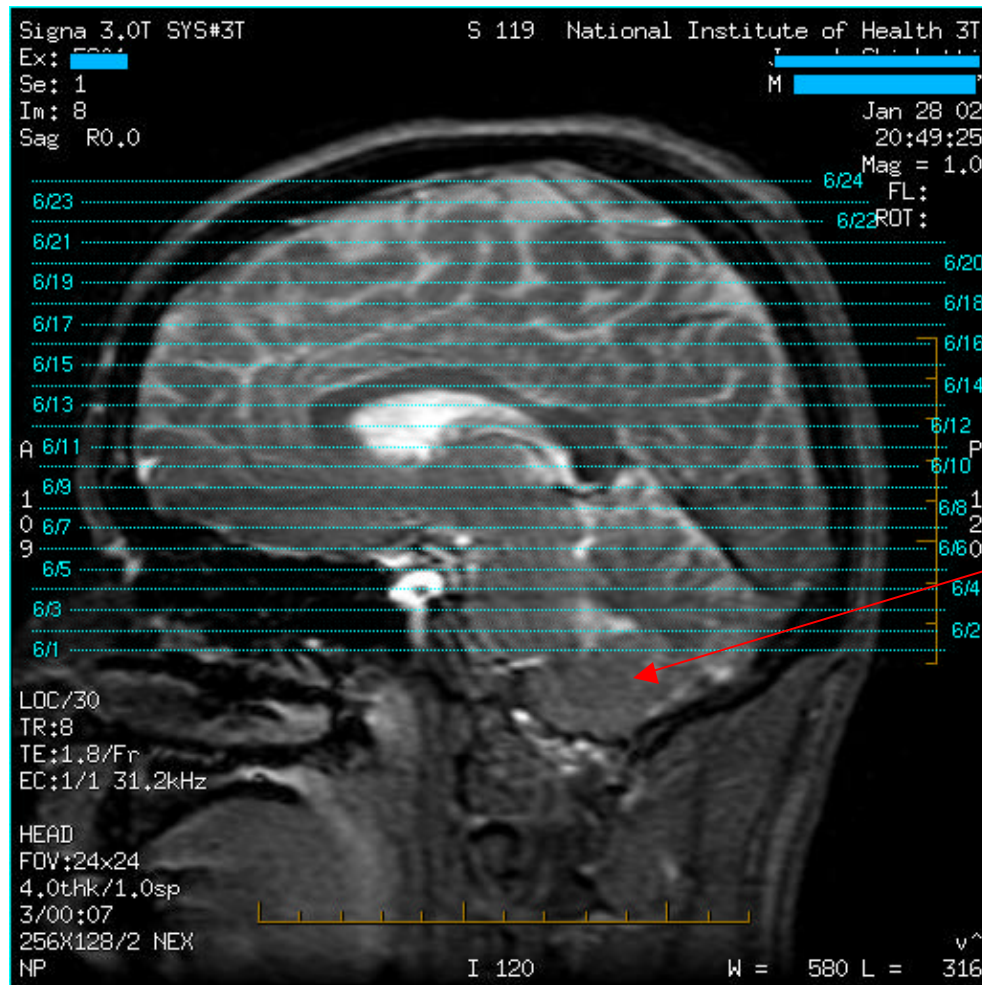
- *Copy RX_ Step 2*
- *Click on correct series and image*
- *COPY RX*
 - *Copies the RX for a previously prescribed series*
 - *Essential for:*
 - *PDW FSE*
 - *T2W FSE*

Using the Copy RX Option



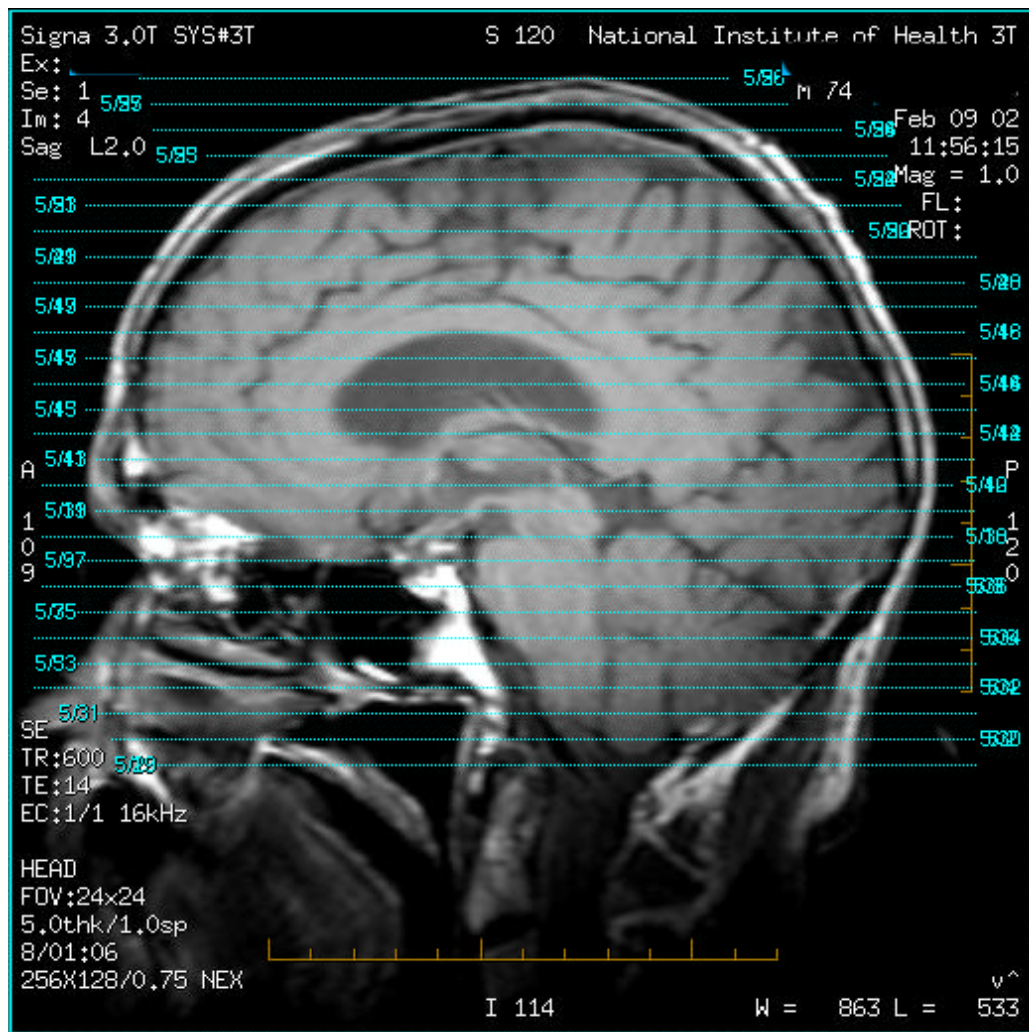
- *Copy RX_Step 3*
- *Image locations should match exactly*

Image Showing Incomplete Clinical Slice Locations



- Inferior brain not covered

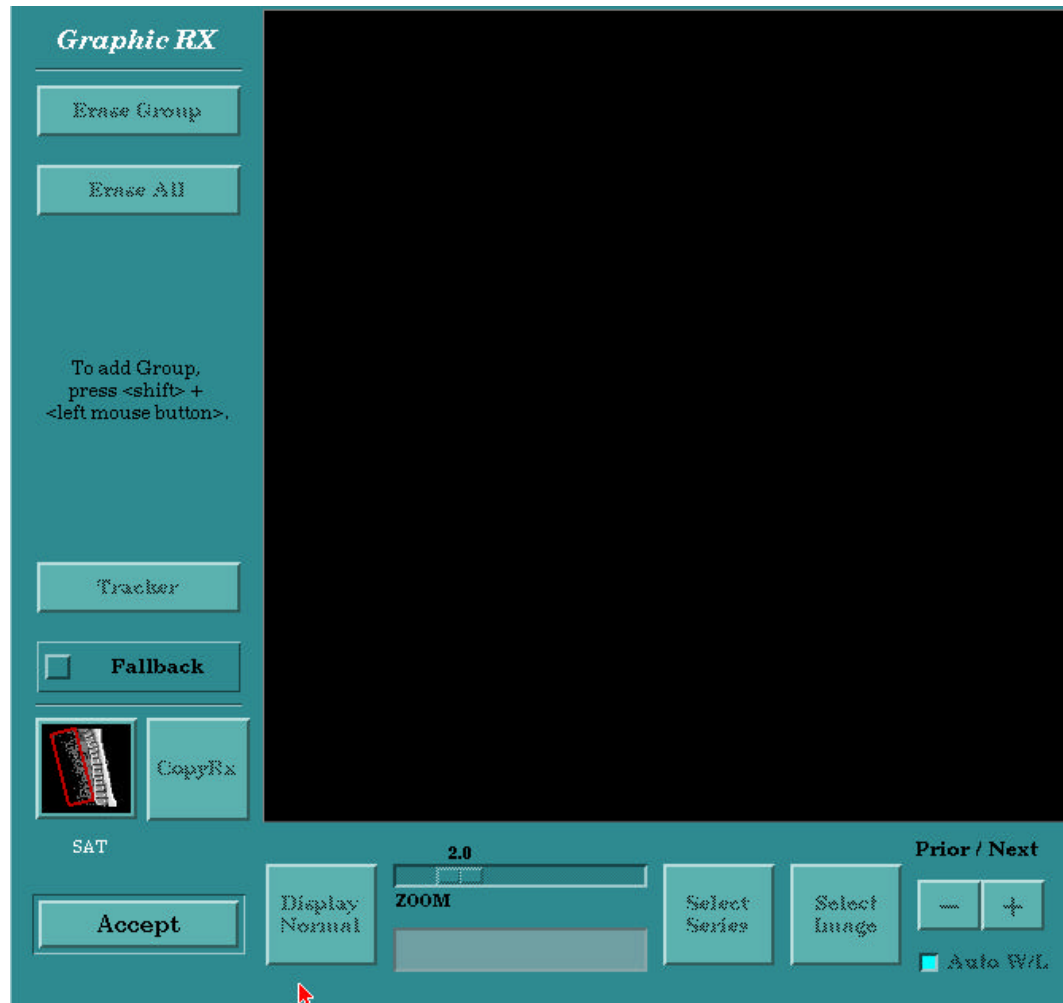
Wasted Coverage on Clinical Scan



- Need only to cover the brain
 - Not above
 - Not below

Invalid Localizer ?

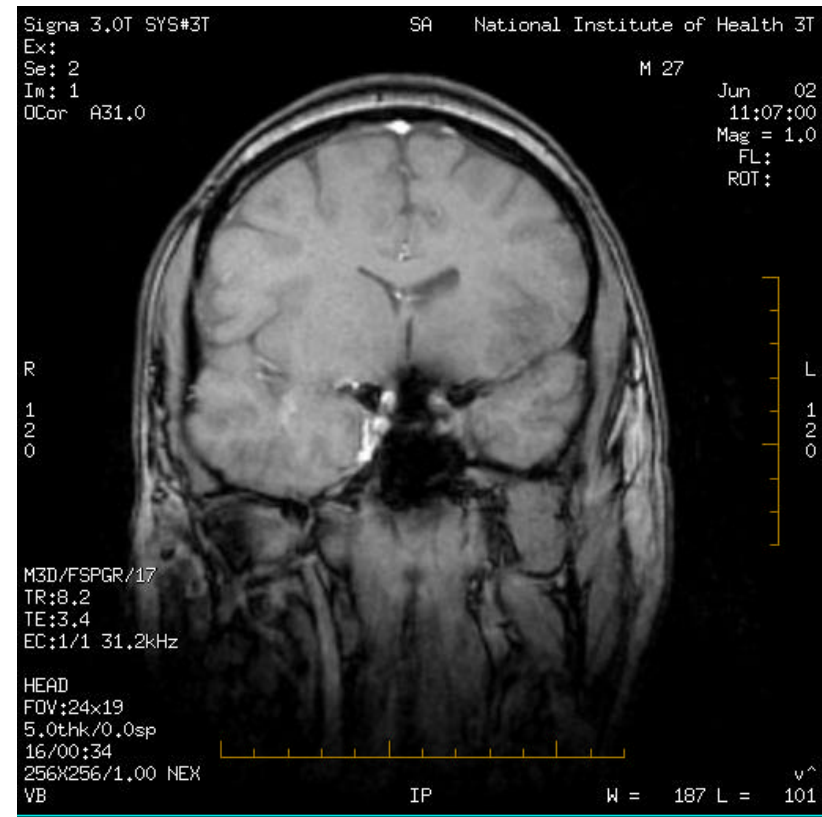
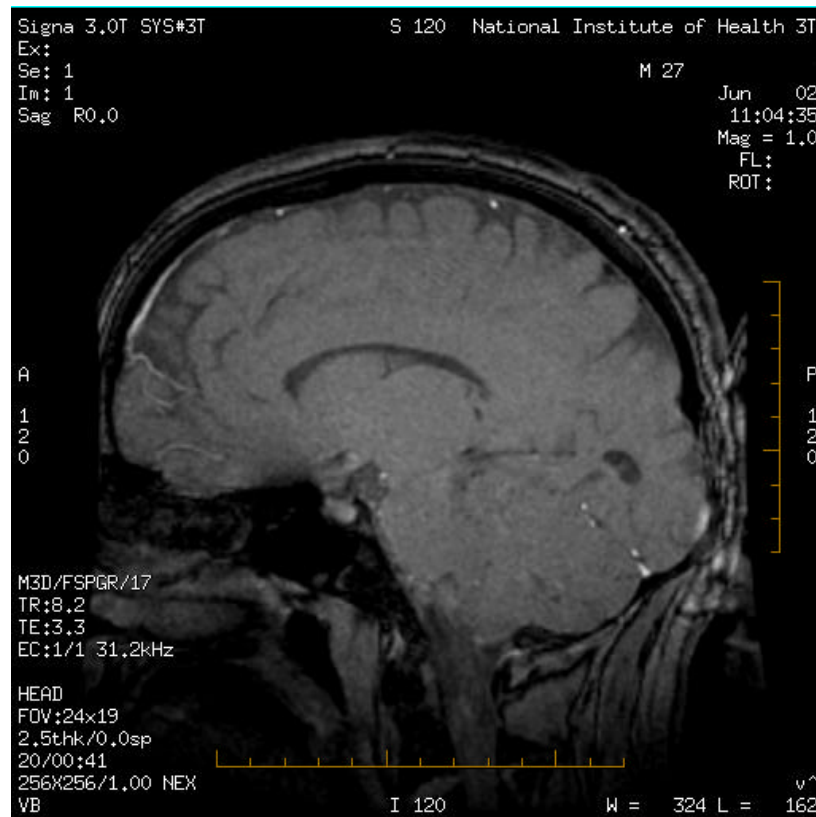
No valid localizers exist for the current prescription.



- Can only prescribe an orthogonal scan plane
- Axial
 - Coronal
 - Sagittal
- Sagittal
 - Axial
 - Coronal
- Coronal
 - Axial
 - Sagittal

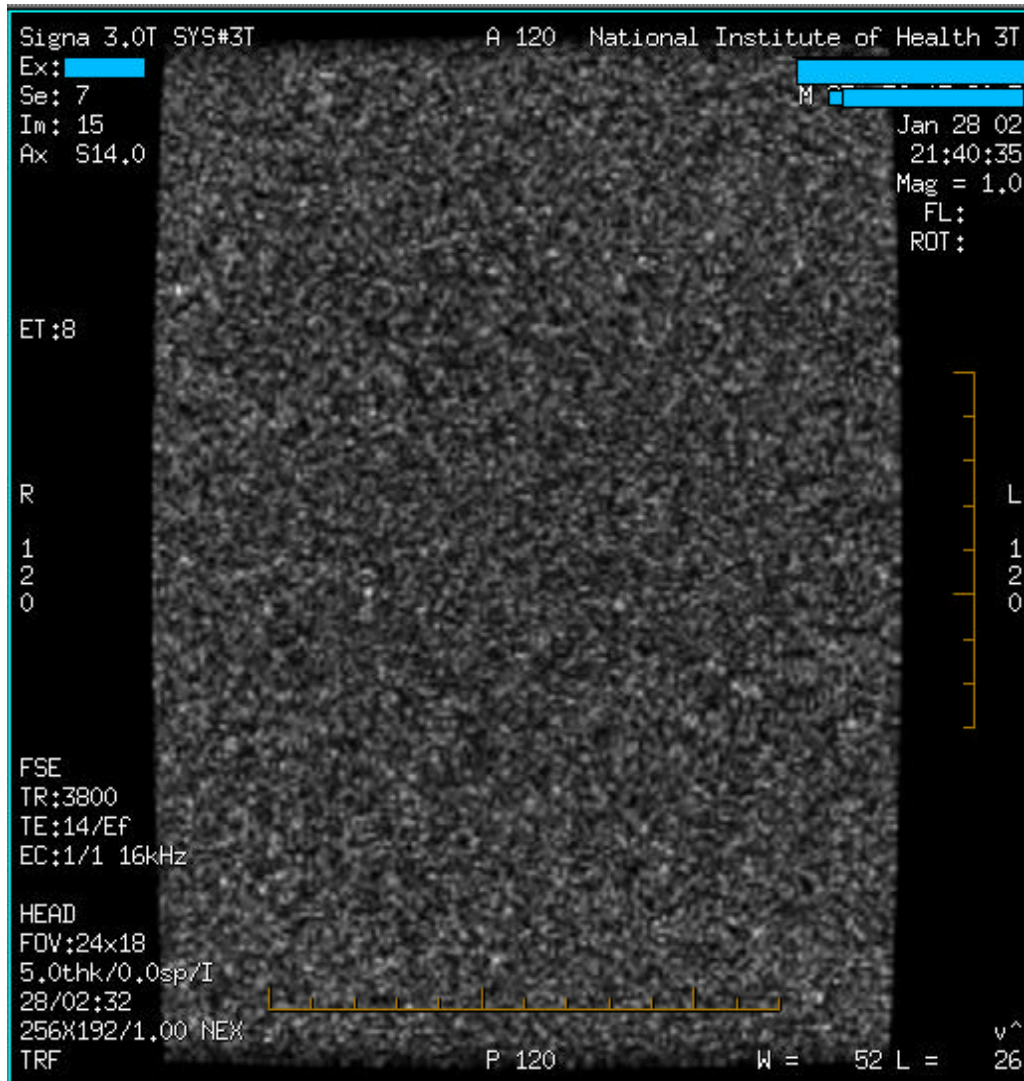
Tech Tips and Tricks

Head Not Straight



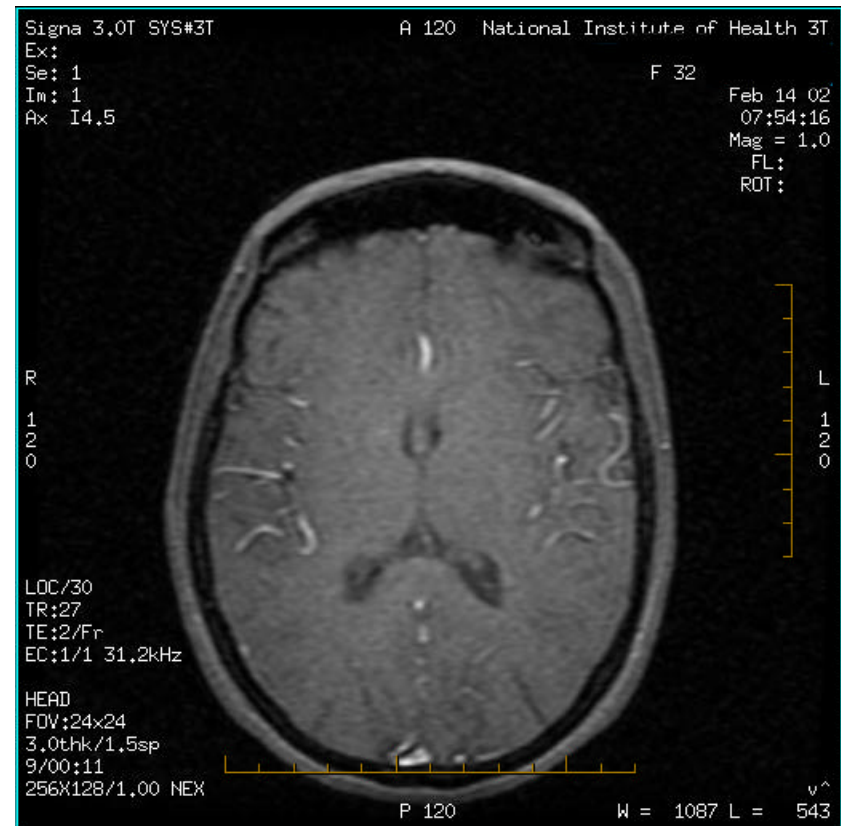
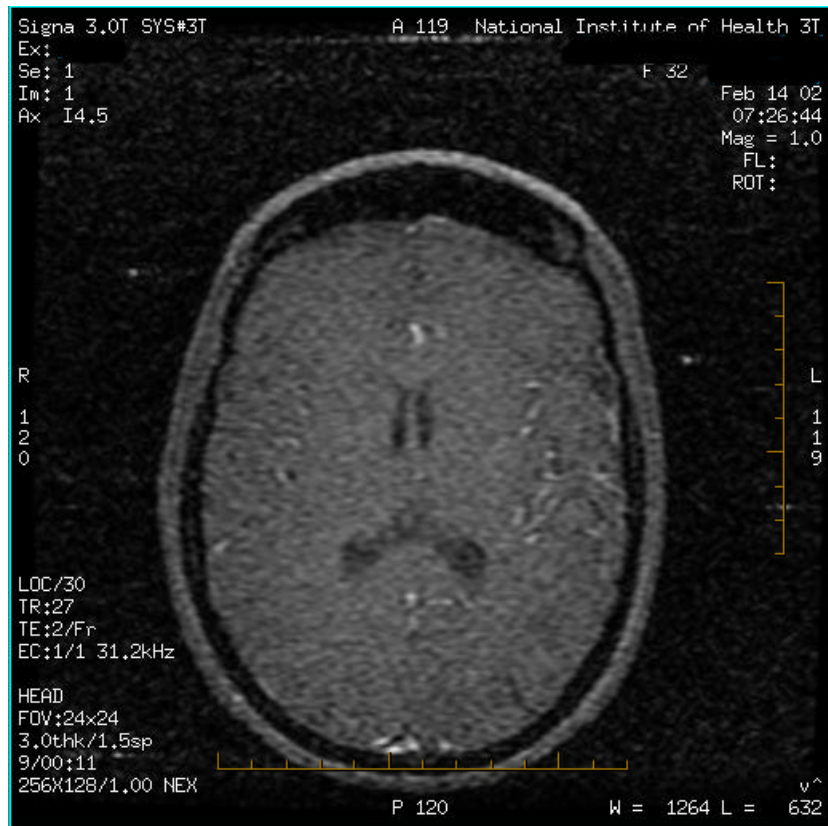
- When starting with a sagittal localizer you risk not knowing if the head is straight. Especially, when there is no midline slice.

Image with No RF



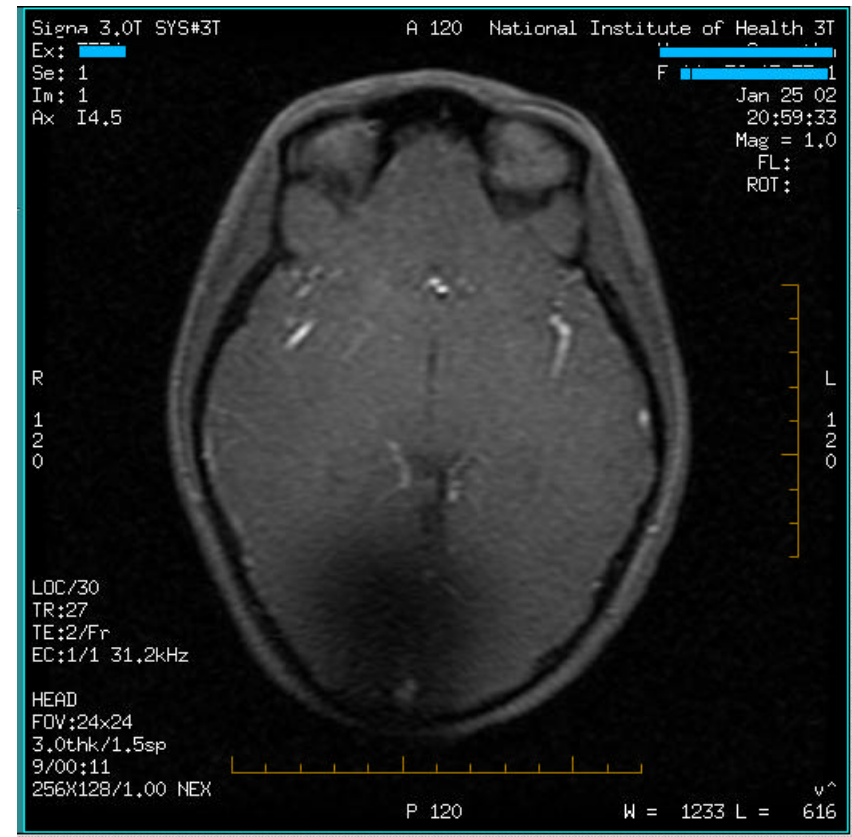
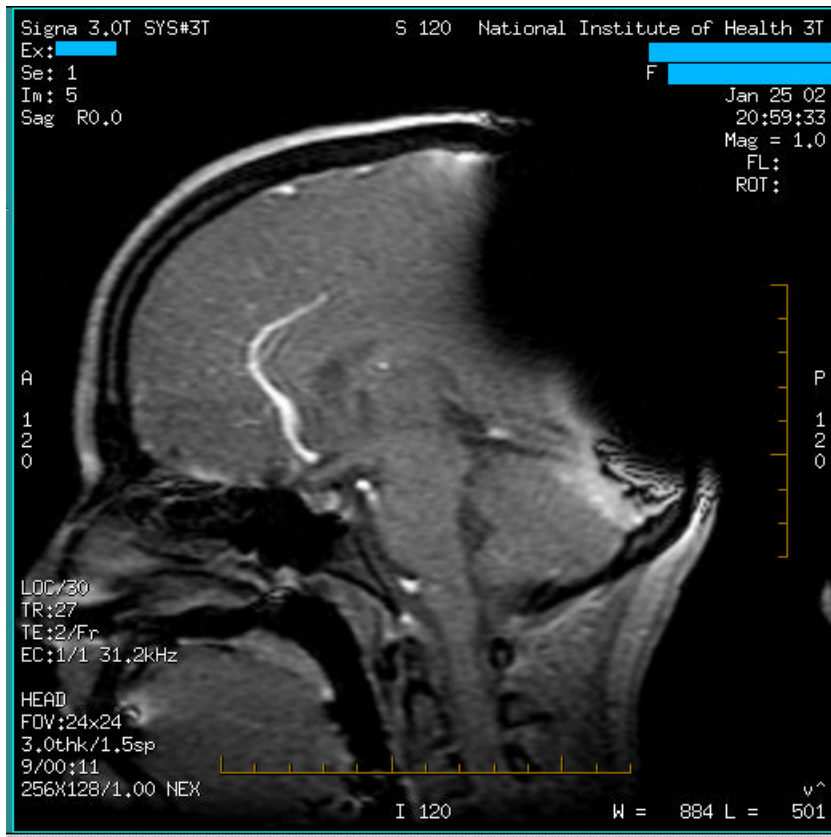
- Check the Power Monitor Status
- Make sure coil is plugged in correctly
- Is the head coil in correct position?
- Did the previous researcher disable the RF?

Noisy Image From a Small Piece of Metal in the Magnet



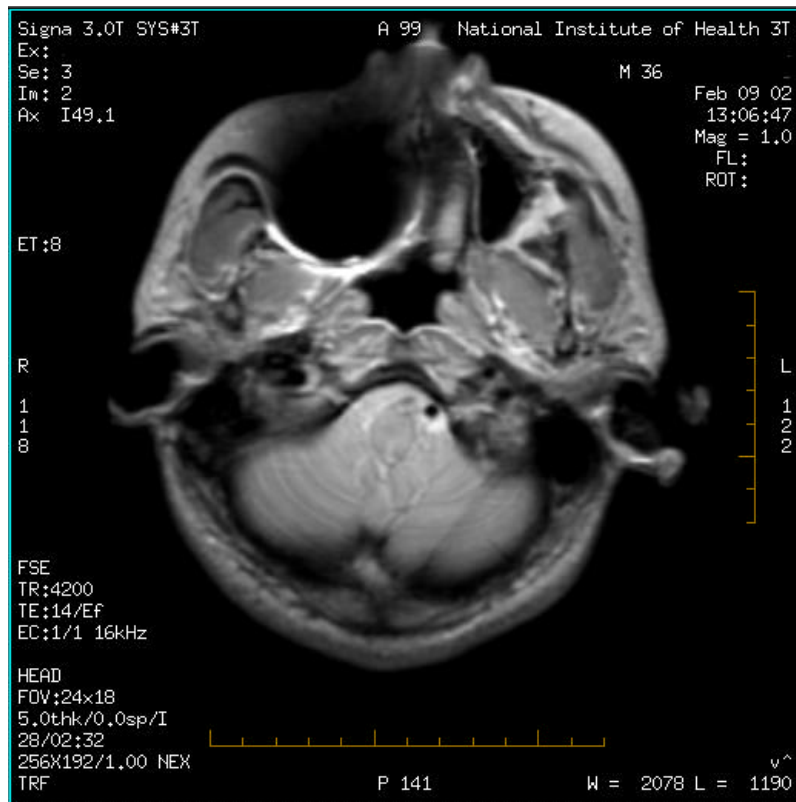
- Same patient, same sequence
- Before and after the removal of a paper clip in the magnet

Trouble Shooting Image Problems

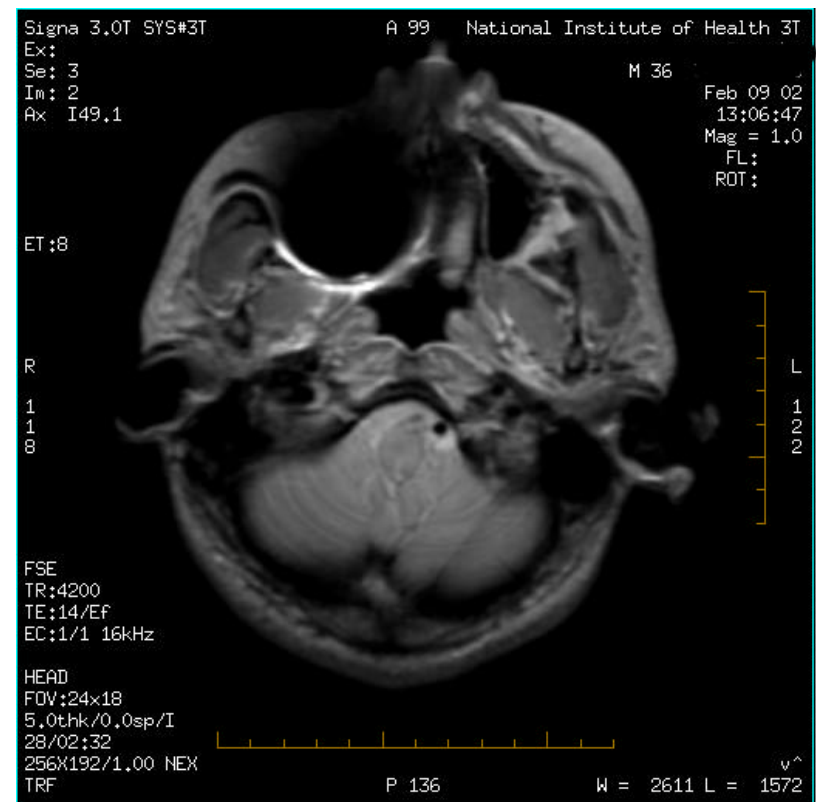


- Hair “Scrunchie”
- Hair bands for ponytails
- etc

Susceptibility Artifacts From Dental Work (Steel Tooth)

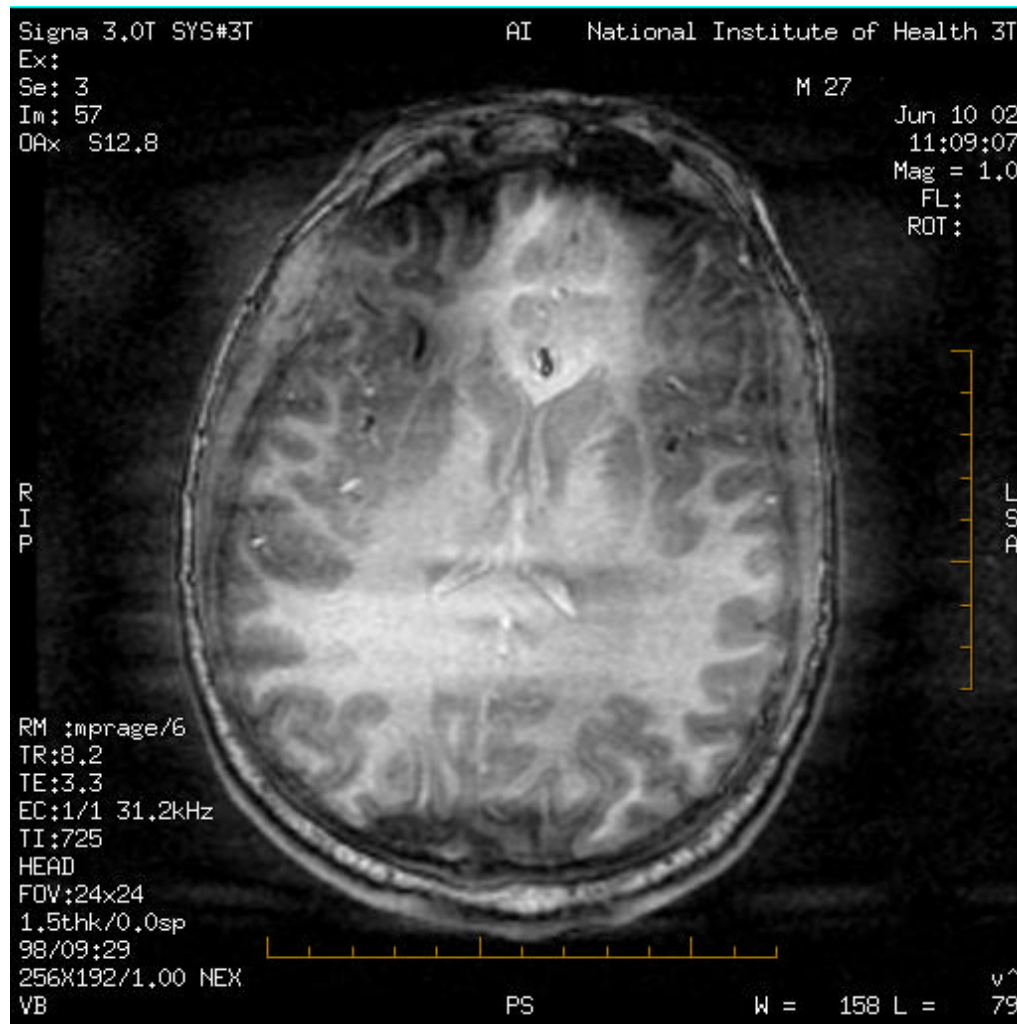


PDW



T2W

Structural Image Distortion



- Patient Motion
- Poor Shim
 - Off Center Frequency
 - Over-range

Additional Images and Useful Information Available at:

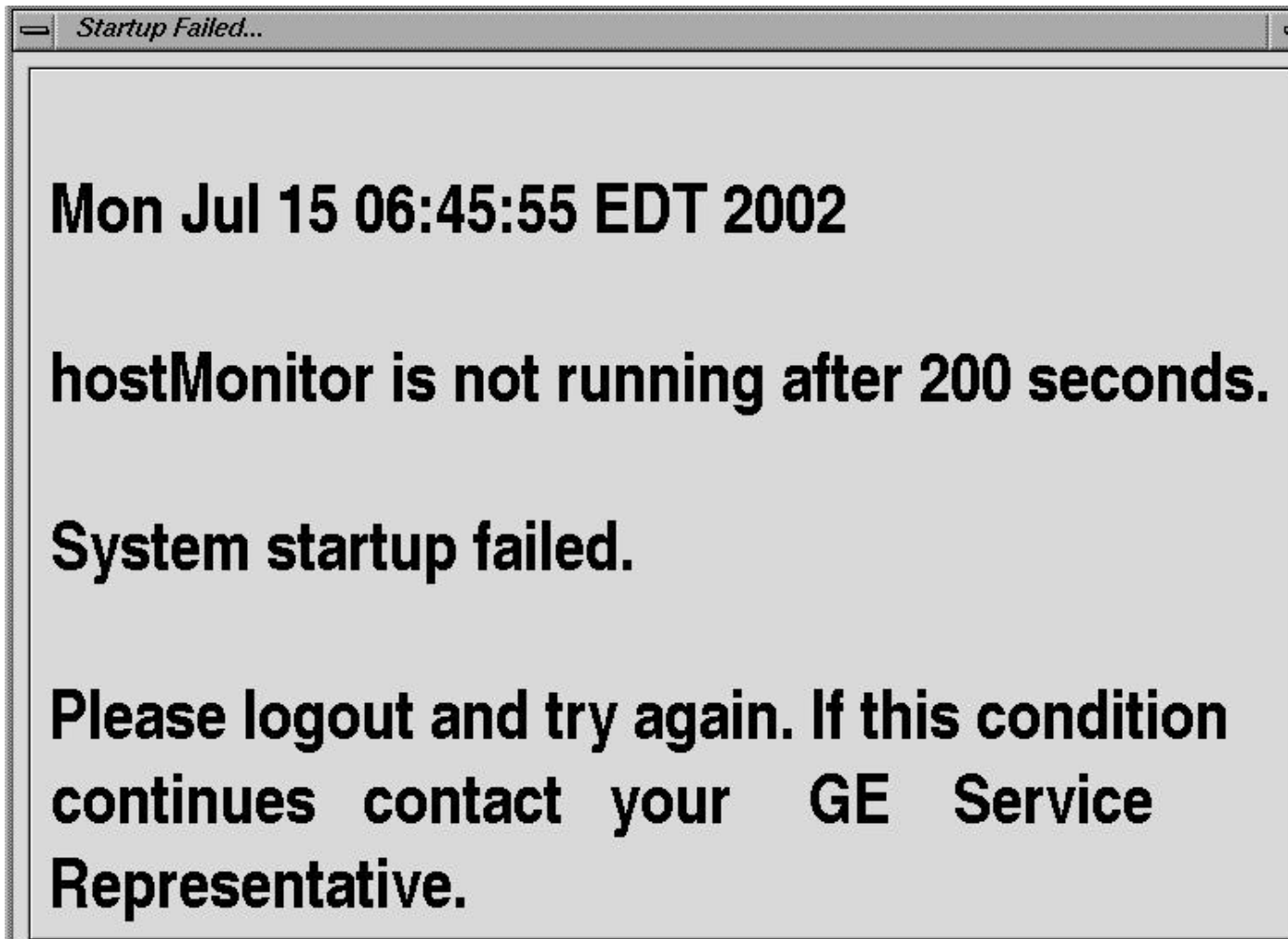
- <http://wwwrad.pulmonary.ubc.ca/stpaulsstuff/MRartifacts.html>
- <http://www.cis.rit.edu/htbooks/mri/>
- http://brainmapping.loni.ucla.edu/BMD_HTML/SharedCode/slides/SlideFiles.html
- http://brainmapping.loni.ucla.edu/BMD_HTML/SharedCode/TINS/FMRI-TINS.html

So, What are we doing?

- Running QA programs
- Stocking the room
- Archiving
- Filming
- Paperwork
- Trouble Shooting database errors

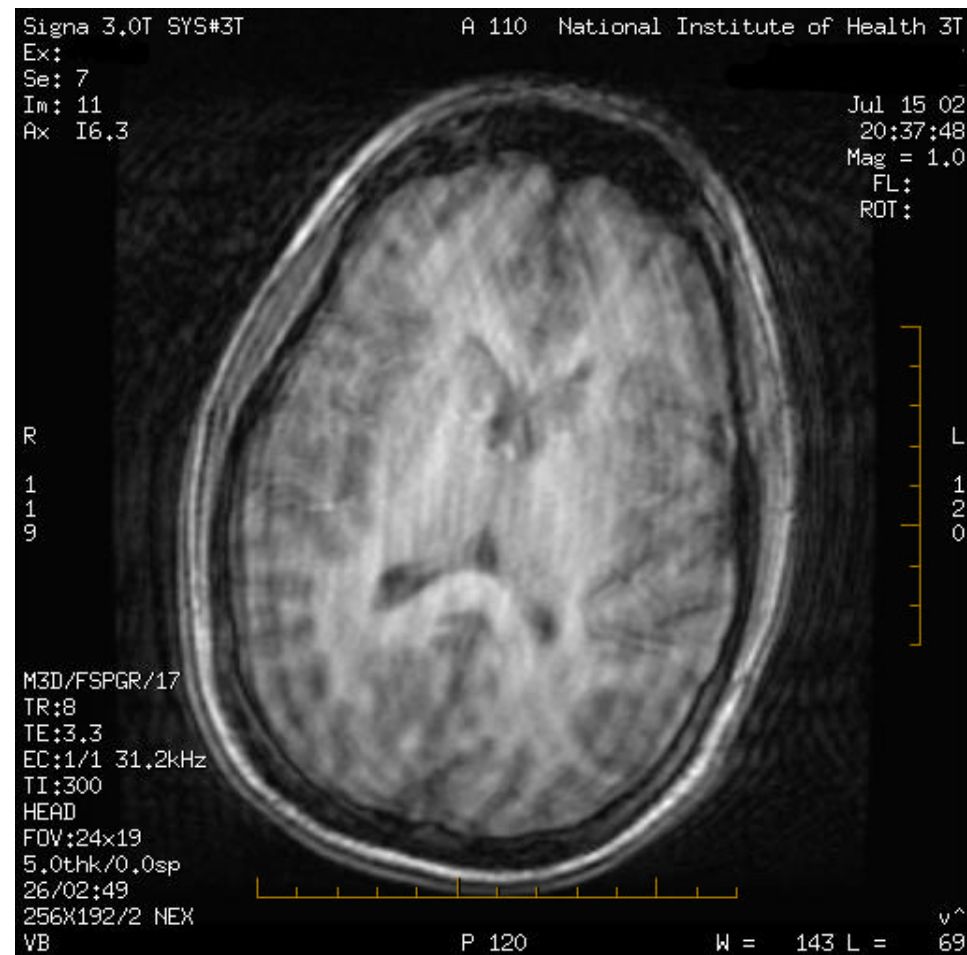


Host Monitor Failure

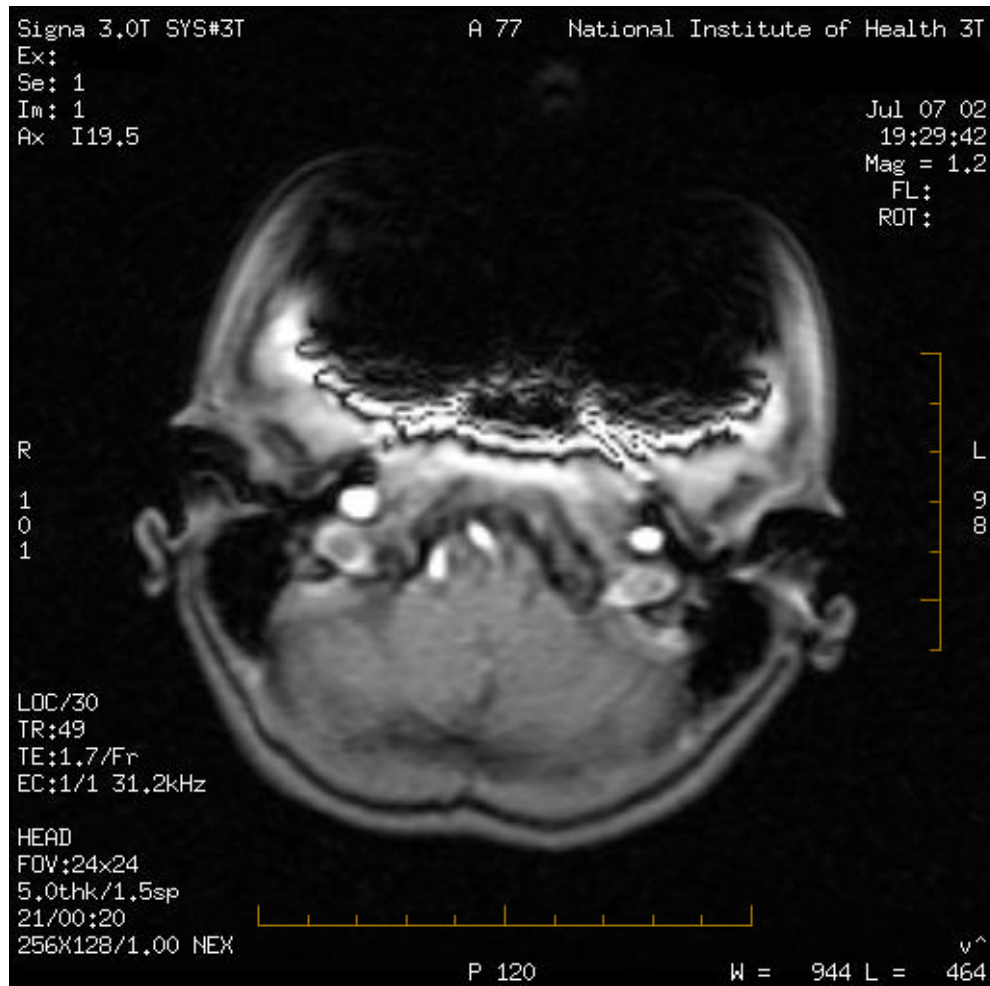


- Can happen during the Start-up procedure
 - rmb
 - logout
 - reboot
 - Signa

Patient Motion Degrading Image Quality

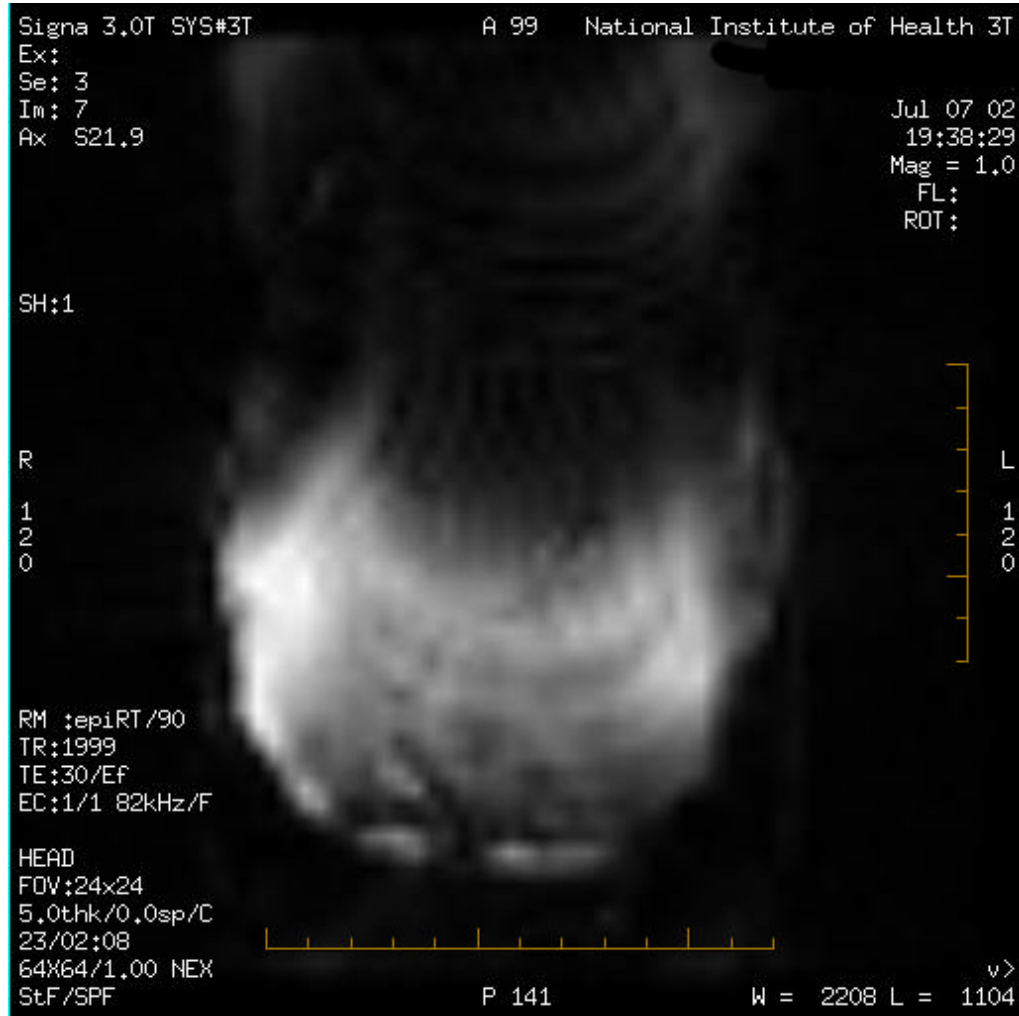


Susceptibility Artifact from Braces (Localizer)



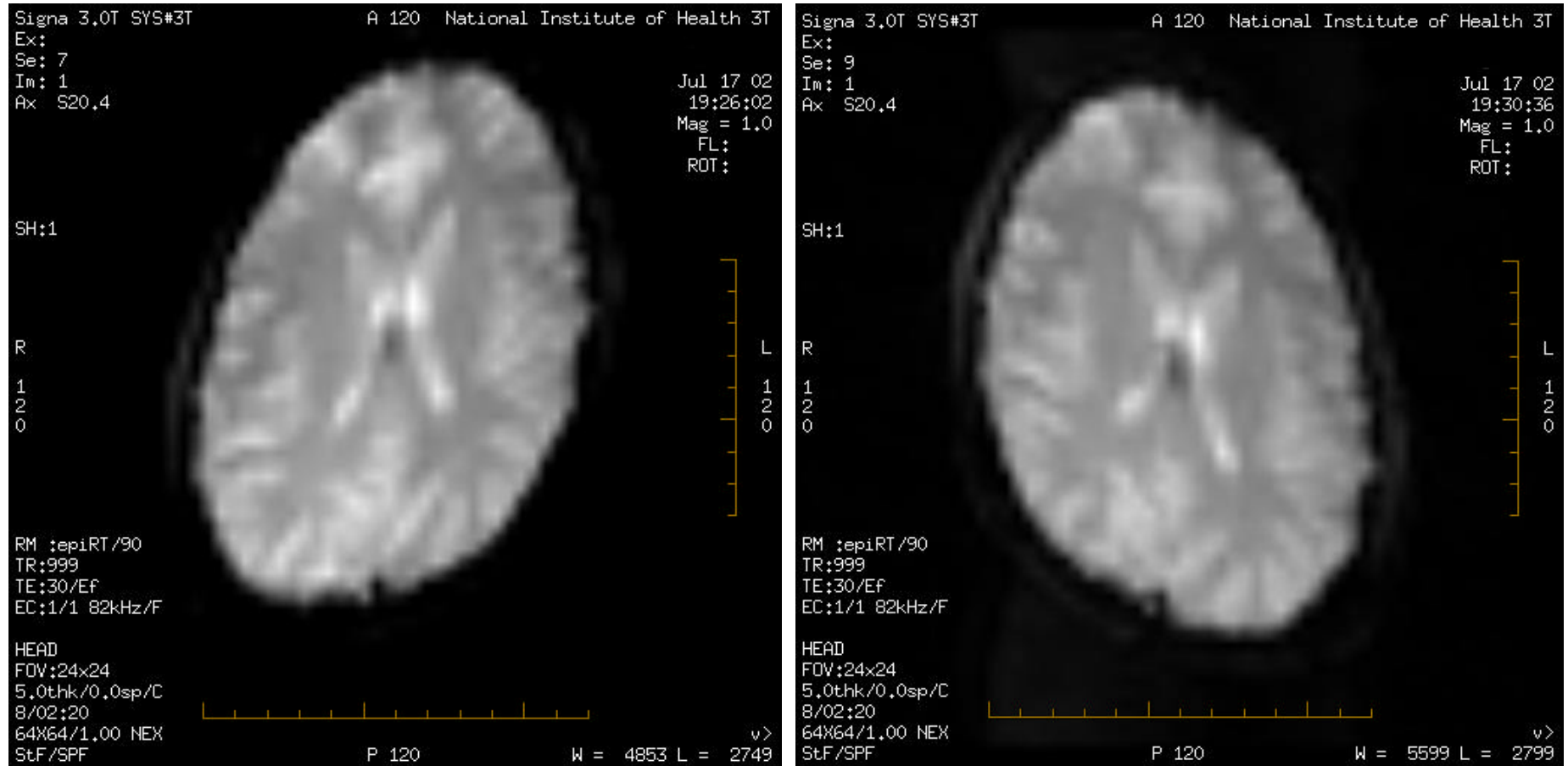
- Patient with braces
- 3-plane localizer

Susceptibility Artifact_Braces_EPI



Not worth scanning EPI

Shims Out



Acknowledgements

3 Tesla Core Facility

NHLBI

NMR F

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GE Medical Systems

Avotec, Inc.

Medrad, Inc.

Berlex Laboratories

ACR Glossary of MR Terminology